MARCH 25¢

FLYING

including INDUSTRIAL AVIATION

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ON

AVIATION'S GREATEST 1942 ACHIEVEMENT

Captain Carder N. McNay, Braniff Airways pilot, predicts a new, peacetime prosperity that will follow America's wartime aviation progress.

"They're Building *Jobs* As Well As *Planes* in Wich

to be ready when you boys come flying h

"BELIEVE me, you fellows in the service have something to look forward to the day that Hitler hollers 'Uncle,'" says Captain McNay. "The airplane that *everyone can buy and fly* is ready now at Cessna to be produced as soon as this war is over. It's the Cessna Family Car of the Air. And Mr. and Mrs. America will be flying it all over America as naturally as they've driven automobiles for years.

"That's not just prop-wash. It's bound
And with it will come thousands of new jo
ing, selling and servicing thousands of Fa
of the Air. What's more, there'll be miles
controlled airways, thousands of airports
strips and service stations to be operated.
means jobs, good jobs and lots of them, for
when they come marching, rolling, flyin

Mrs. America Wins Her Wings

Remember, Mrs. America likes to go places and see things. And when she finds out that she can cover 600 miles in a morning, to shop or visit in any one of a dozen cities, she's *going to fly.* And nothing can stop her.

Yes, she'll be flying, taking off and landing, as easily as she drives her car, in a few hours after she first steps in a plane. Compared to the hundreds of American women flying today, hundreds of *thousands* will fly in the post-war tomorrow. Why? Because it's going to be *as easy as that* for you to fly the Family Car of the Air.

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SYMBOL OF *Aircraftsmanship* FOR THIRTY-ONE YEARS

TO THE MEN AND WOMEN OF CESS

ARMY E NAVY

FOR HIGH ACHIEVEME

On behalf of the men and women of Cessna, w
proud to accept this joint Army-Navy award for "
Achievement in the Production of War Material."

Far more to all of us than a symbol of a job well d
it flies over the Cessna plant today as an inspiratio
the task ahead . . . signifying the spirit and deter
tion of all free men to work on, fight on, tirelessly
Victory is won.

Dwane Wallace
Presid

Get Your *"Keep 'Em Flying" Wings* FREE N

Yes, these handsome "Heel Hitler" wings are free.
get them with a Jap Hunting License by simply sen
10 cents for a U. S. War Savings Stamp to us with
name and address. So send today for your free Wing

CESSNA AIRCRAFT COMPA
Department FPA, Box 1616, Wichita, Ka

If You Have a Genuine Interest In Aviation as a Career —

If You Want to Serve Your Country Best in Time of War —

Enter PARKS AIR COLLEGE!

You who can answer these statements in the affirmative will do well to consider taking up Parks Leadership Training as soon as you can qualify.

Parks is continuing its aviation training for a capacity enrollment of civilian students. It is expected that this contribution to the war effort of our country will continue.

You want, first of all, to do everything you can to aid America in these critical times — yet, if you are sincerely interested in aviation as a lifetime career, you should also look beyond the present.

The better prepared you are to accept positions of responsibility and to forge ahead to leadership, the greater your value to your country and to the future progress of aviation as well.

As a graduate of Parks, you will be equipped with a broad, thorough education. You will have acquired a grasp of the aviation industry both from the technical and the executive viewpoint — trained to make the most of your opportunities, to be of greater value in whatever fields you serve, in War or Peace.

If you are genuinely interested in receiving training which will enable you to be of the greatest value to your country as well as to the aviation industry, if you are a high school graduate and ranked in the upper two-thirds of your class, or if you are still in high school as a junior or senior, you should write at once to Parks for complete information.

The coupon below brings you the 64-page Parks Catalog with full information on each of Parks' four courses. Send a postcard request or mail this coupon today.

PARKS AIR COLLEGE founded August 1, 1927. Has enjoyed full Federal approval longer than any other aviation school.

Is accredited in its Aeronautical Engineering School by the Illinois Superintendent of Public Instruction.

Included since 1938 in The Directory of Colleges and Universities, issued by the United States Office of Education.

Has a capacity enrollment of 300 commercial aviation students, also detachments of U. S. A. Air Forces Aviation Cadets and Mechanics.

Has its own airport with a school plant of 25 buildings devoted to school purposes entirely, also a group of fields for military flight training.

Has a faculty of 104, each especially qualified for his particular field of instruction.

Open to high school graduates with a ranking in the upper two-thirds of their classes.

PARKS AIR COLLEGE Section F-3
East St. Louis, Illinois

Please send me details of four major courses in commercial aviation training.

Name..... Age.....

Address.....

City..... State.....

PARKS AIR COLLEGE, East St. Louis, Ill.

FLYING

VOLUME XXXII — *including* INDUSTRIAL AVIATION — NUMBER 3

Contents FOR MARCH, 1943

ENGINEERING

The Hurricane	Sir Frank Spencer Spriggs	28
Engines and Altitude	Rex Sydney	30
Spars by Radio	George R. Reiss	33
Safety Sleuths	Sanford S. Little	36
The Nose of the Airfoil	Raoul J. Hoffman	63
Test Experts	William F. Boni	69
Maintenance Cooperation	Robert J. Curry	105

MILITARY

War in the Air		22
Aces for China	George H. Copeland	26
Helicopters for War?	Rowland Carter	38
Air Force on File	James Montagnes	102
Old Bag of Bolts	Maj. Ben H. Pearse	108

COMMERCIAL

Aviation's Greatest 1942 Achievement		18
Landplanes or Flying Boats for Cargo?	Theodore P. Hall	20
Constellation	Paul Pierce	35
The Wrights Were Right	William Levenor	39
Lancaster Production		41
Industry Row		62
Dixie Dusters	Donn Hale Munson	84

TRAINING

Carriers Coming Up!	Lieut. Fred Tupper, Jr.	42
'Observe and Report'	Lieut. Thurman E. Bercaw	46
Tough Baby	William D. Strohmeier	48
The Civilian Instructor Comes Through	Capt. Allen C. Rankin	55
Navigating Professor	Kurt Rand	59

PRIVATE FLYING

It Takes Sense to Fly!	John R. Hoyt	57
Wartime Air Insurance	Fred C. Crowell, Jr.	70
Service for Tomorrow	Edward Churchill	87

TRANSPORTATION

Air Traffic to Come	Glen A. Gilbert	45

WASHINGTON

Report from Washington	William B. Ziff	44
From Headquarters	Lieut. Col. Harold E. Hartney	62

DEPARTMENTS

At Deadline		14
For Identification		49
Air Services Section		52
AOPA News		58
Have You Seen?		60
I Learned About Flying from That!—No. 43	F. H. Christensen	64
Letters		66
Industrial Aviation Section		91
The Library		147

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SAFE TRAINING FOR YOUR CAREER IN AVIATION

With thousands of men taking advantage of opportunities in the war program: in the aircraft industry, many are untrained. many are "quickie course" graduates and all are eager to do their part . . . it is not difficult to find a TEMPORARY spot. But, if you seek an important supervisory position. in the industry. or a high technical rating in the U. S. Air Forces, you must have thorough training for today's assignment. and for tomorrow's; only such long range training can fit you for a career in the tremendous expansion of civil aviation after the war.

The executives who have made aviation THEIR career know the value of each man is governed by two factors: his intelligent sincerity in selecting aviation as his life work. and THE ABILITY AND EXPERIENCE OF THOSE WHO TRAIN HIM FOR THAT CAREER. They know that Curtiss-Wright Technical Institute graduates are—and for many years have been—thoroughly qualified to fill the industry's requirements.

Located in the very center and a very important part of Southern California's great aircraft industry, with its more than two billion dollars in unfilled orders, Curtiss-Wright Tec has come to be recognized as the nation's leading institution for the training of Aeronautical Engineers and Master Mechanics.

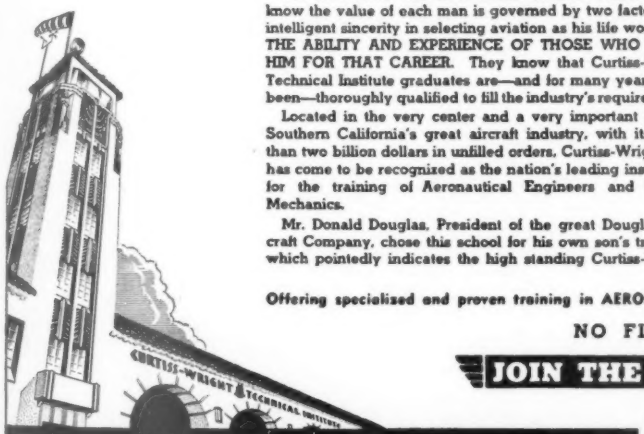
Mr. Donald Douglas, President of the great Douglas Aircraft Company, chose this school for his own son's training, which pointedly indicates the high standing Curtiss-Wright Tec has attained in the aircraft industry since its establishment in 1929.

It is imperative that before you invest in a course of career training you determine what the returns will be on your investment . . . for your choice of a school in which to take your training will determine how much money you will make the rest of your life.

Curtiss-Wright Tec's career training is carefully designed to do just one thing:—TO MAKE MONEY FOR YOU, so upon graduation you can be independent and self-supporting for life. Our thousands of successful graduates have proven Curtiss-Wright Tec training gets results and alway pays, since it trained them in advance for the highest position they could ever expect to occupy. It can do the same for you.

This school has never guaranteed positions for its graduates, but practically every graduate has obtained immediate employment and is advancing rapidly. The demand for our graduates far exceeds the supply, and we honestly believe every student who enrolls here will be able to obtain, with our assistance, immediate employment upon graduation.

WARNING!—"Don't miss the boat." The greatest opportunity in your lifetime exists today! There never was such an opportunity in aviation for you; there may never be another. A position awaits you. Insure for yourself a steady income and independence for life. DON'T FOLLOW—LEAD! Send in your enrollment before you "miss the boat."



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Offering specialized and proven training in AERONAUTICAL ENGINEERING & MASTER MECHANICS

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CURTISS WRIGHT TECHNICAL INSTITUTE

GRAND CENTRAL AIR TERMINAL 1225 AIRWAY GLENDALE (LOS ANGELES) CALIF

UNDER PERSONAL SUPERVISION OF MAJOR C. C. MOSELEY, OWNER, SINCE ITS ESTABLISHMENT IN 1929

Contractor to the U. S. Army Air Corps

BE WISE—PROTECT YOUR FUTURE

MAIL TODAY • DON'T DELAY

WITHOUT COST OR OBLIGATION—SEND ME FULL INFORMATION AND CATALOG ON THE COURSE CHECKED BELOW

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- ☐ MASTER AVIATION MECHANIC COURSE
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NAME

ADDRESS

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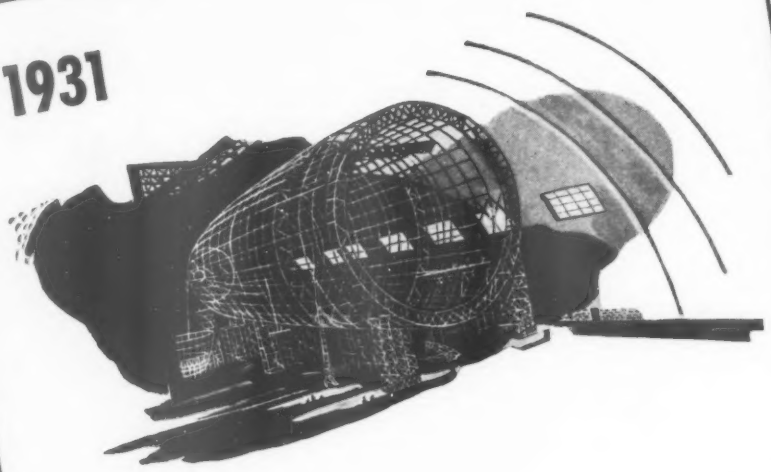
Trail Blazing in the Skies

1931

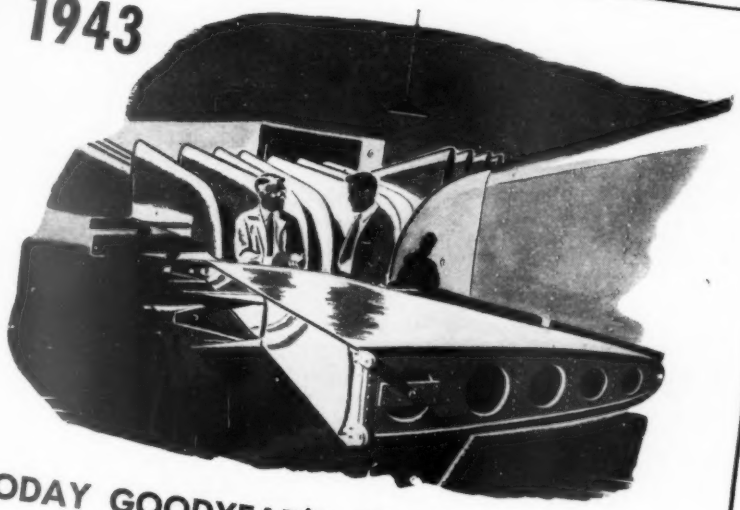


THE LARGEST AIRCRAFT STRUCTURES ever to be built of duralumin in this country were fabricated by Goodyear. Our experience in forming duralumin sections for use in both airplanes and airships goes back to 1923. Most of the duralumin alloys that have been widely used in aircraft construction since then were first produced to meet airship specifications.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AVIATION INDUSTRY

1. *By building parts to manufacturers' specifications.*
2. *By designing parts for all types of planes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or construction problem.*

1943



TODAY GOODYEAR'S SKILL IN DURALUMIN FABRICATION is helping many of America's most famous airplane manufacturers meet their wartime production schedules. For these companies we are mass-producing wing and tail subassemblies, control surfaces, fuselage and cabin sections. All this is in addition to Goodyear's own production, as a primary contractor, of both complete airplanes and airships for the United States Navy.

GOODYEAR

GOODYEAR AIRCRAFT

Drawn by Clayton Knight

FIVE REASONS WHY BOOTS IS A BETTER NUT

1. Lighter weight.
2. Greater re-usability.
3. Unaffected by oil, gasoline, marred bolt ends, or cross-drilled bolts.
4. Effective under high temperatures, low temperatures, and sudden temperature changes.
5. Has approval of all Government agencies for aircraft or engine construction.

THESE PLANES FLY WITH THEIR BOOTS ON

Boeing Flying Fortress.
Brewster Buccaneer.
Cessna Trainer.
Consolidated Liberator, Coronado, Catalina.
Curtis Commando, Dive Bomber, Plywood Plane, Scout Observation Planes.
Edo Floats.
Fairchild Trainers.
Grumman Wildcat, Avenger.
Martin Bomber, Flying Boat.
North American Mustang.
Republic Thunderbolt.
Vultee Trainer, Vengeance Dive Bomber.
Waco Glider.

FOR ENGINE MANUFACTURERS

The **Rol-Top** "hex" nut, latest addition to the Boots Self-Locking Nut family. Specially designed for engine application, the **Rol-Top** Nut does its job under higher temperatures, exposure to gasoline and other destructive elements.

They Fly with their Boots on— a million lbs. lighter!

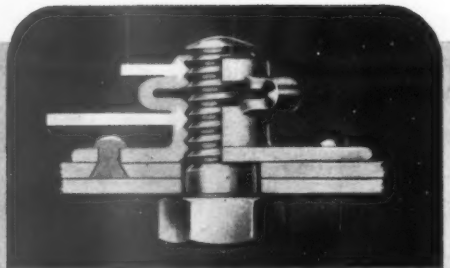
Fighter planes, bombers, cargo planes, trainers, gliders . . . all types of aircraft today "fly with their Boots on." And, because of this fact, they'll fly lighter—*by a million pounds.* For Boots Self-Locking Nuts—the important anchor and channel types—are stamped from sheet metal.

Besides making America's planes a million pounds lighter, they *save* a million pounds in strategic metals.

Government authorized, self-locking nuts . . . all-metal . . . "lighter and everlasting" . . . therefore better in operation and maintenance.

Today engine manufacturers are making extensive use of another Boots item—the "Rol-Top," all-metal nut.

All of which means that we have *better* planes, and *lighter* planes . . . with less consumption of metal, when they fly with their Boots on.



HOW IT WORKS

The Boots Self-Locking Nut is one-piece, all-metal—withstands severest vibration. The top (locking) section is displaced in a downward direction . . . locking threads are out of lead with load carrying threads of lower section.

Upon insertion of bolt, top section of nut is extended to engage with threads of bolt. A constant force is thus established which locks nut firmly into position. Axial thread play is eliminated.

BOOTS

Boots Aircraft Nut Corporation

Self-Locking Nuts for Application in All Industries

GENERAL OFFICES: NEW CANAAN, CONNECTICUT

The Birdmen's Perch

Flutter called our attention to an article in the newspaper a few days ago.

We wish we had a smoke tank in the Gulfhawk—we'd go upstairs and write the article all over the sky. Maybe not the whole thing . . . but there's one statement in it that everybody who's done any grousing about fuel or gasoline rationing should know:

"*Two thirds of the tonnage of supplies allotted to each soldier on the second front is oil!*"

Guess that settles *that!*

Major Al Williams,
alias, "Tattered Wing Tips," Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

SUPERCHARGING AND SUPER-REFINING

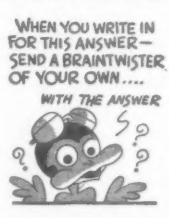
If you were building warplanes, one of your biggest problems would be to make them fly *higher*.

The first thing you would do to get more altitude would be to fit your plane with the best engine known. This engine would make your plane fly high—but not high enough. Because above certain altitudes, the engine wouldn't get enough air. So you'd get more air to the engine by supercharging. With supercharging, more of your fuel mixture would burn, less of it would go out the exhaust, and you'd get better performance from your plane.

If you were refining oil, one of your biggest problems would be to make the oil *cleaner*.

The first thing you would do to get more dirt out of your crudes, would be to use the best refining methods known. This would clean the oil—but not enough for Gulf. Because beyond a certain point, ordinary refining methods don't remove enough of the carbon-makers and sludge-formers. Gulf gets *more* of these out of Gulfpride by the exclusive Alchlor Process. With this technique, more of Gulfpride actually lubricates, less of it forms carbon, sludge, and gum . . . and you get better performance from your engine.

DIMINISHING BRAINTWISTER



A plane made 5 stops between WA and LA. At each stop, half the passengers aboard left the plane. And at each stop passengers came aboard, starting with 5 passengers at the first stop; 4 passengers at the second stop; 3 at the third stop; 2 at the fourth stop; 1 at the fifth stop. The plane arrived at LA with 5 passengers. How many were aboard when it left WA?

A FEW CUTTING REMARKS

Machine tools cut mechanical parts out of metal stock the way a boy whittles toys out of wood.

But cutting steels, bronzes, and aluminum builds up terrific friction heat on the tool—or "knife." To dissipate this heat and obtain a better finish on the work, a constant stream of "cutting oil" is played on the cutting tool.

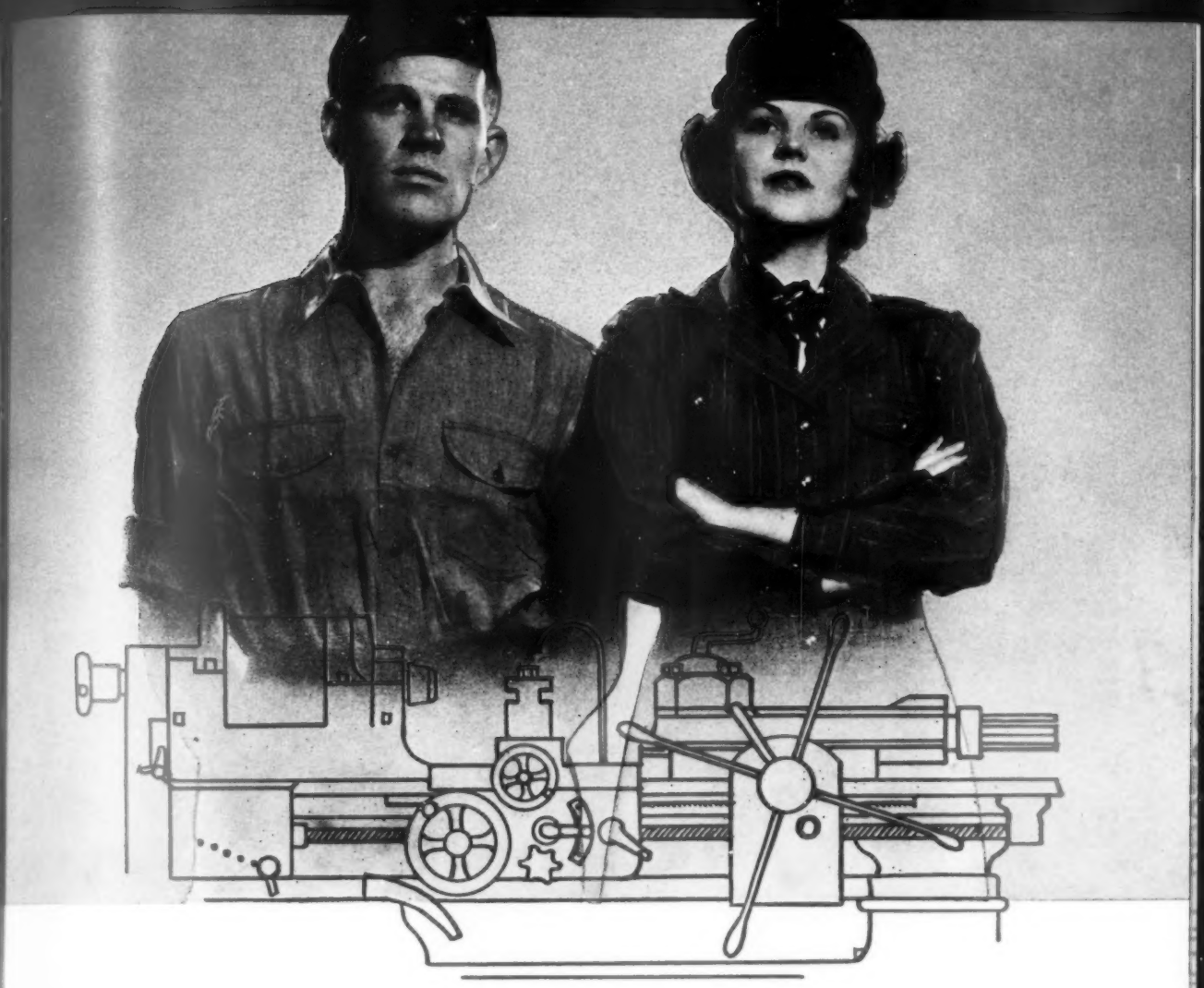
In a recent demonstration, Gulf Cut-Aid—a new cutting oil perfected by the scientists in Gulf's Research Laboratories—was used on a machine that was throwing up a plume of smoke while operating at 100 surface feet a minute. After the new cutting oil was added to the lubricant already in use, there was not a trace of smoke at *300 feet a minute!* In another operation, Cut-Aid extended tool life from 3 hours between regrinds to 11 hours, and the finish on the aluminum that was being formed was declared changed from "fair" to "excellent."

Gulf Oil Corporation and Gulf Refining Company... makers of

GULF AVIATION PRODUCTS

OIL IS AMMUNITION—USE IT WISELY!

THE OIL SUPPLY DRAIN MUST BE SUPPLIED WITH A SUITABLE LOCKING CAP WHICH CANNOT...
... INADVERTENTLY OPEN IN FLIGHT. EVERY PILOT SHOULD MAKE A POINT OF SEEING THAT ...
..DRAINCAPS ARE SAFETIED OR LOCKED AFTER OIL CHANGES! AND EVERY PILOT SHOULD MAKE A POINT OF...
USING THAT GOOD GULF AVIATION GASOLINE!
G.A.G.



A Help on Your Job... Because Chewing Helps the People Who Make the Goods With Which Our Fighting Men Win the War

Chewing Gum's Relief from Tense Nerves, "False Thirst," Saves Man-Hours. Helps People Feel Better, Work Better

Only People Can Win This War!

The machines are vital but they are mere lumps of dead metal without people to run them. People with the will to win—people with high morale and healthy nerves.

Because chewing gum helps the human side of the machine—people—it has taken on a new job—a war job. Scientists have found the basic reasons why chewing helps people feel better, have steadier nerves and work better. They have traced the results in laboratory tests.

And they have found why chewing relieves false thirst—dry mouth and throat that pester workers and send them on "sip-trips" to drinking fountains—even when the body wants no water. And in hundreds of war plants, production managers find chewing relieves the craving to smoke, where conditions make it impossible to permit it. And how it helps lessen fatigue and lifts morale.

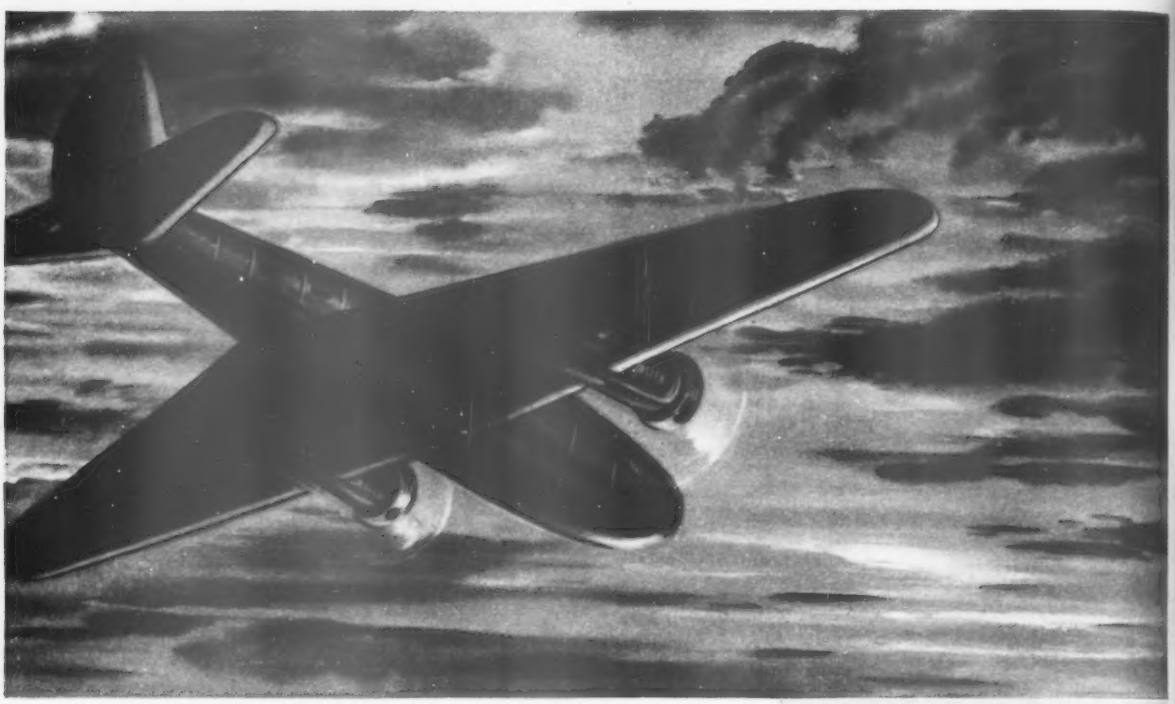
Also they find that chewing fights drowsiness, helps keep workers alert and reduces accidents. In these ways chewing gum saves many man-hours now wasted.

And the Armed Forces and people everywhere are finding out how they benefit from chewing gum. That nerve tension is eased and the task goes easier, faster. And so the demand for chewing gum is outstripping our capacity to produce it.

But we are doing our best to get gum to you—in short to get it to the places it will do the most good. That is why we say to you important production people: "If you want to salvage man-hours and help the human side of your machine feel better and work better, see that they have chewing gum on the job, as hundreds of war production plants now do." And we will do our best to get it to you. For only people can win the war.

Wrigley's Spearmint Gum—A Help on Your Job

X-54



"LEARADIO EQUIPMENT used in our Air Cadet Training School"

. . . says COL. ROSCOE TURNER

World-renowned Flyer, Three-time Winner of the Thompson Trophy, National Air Races, Cleveland.

The Boeing 247 aircraft shown above, piloted by Colonel Roscoe Turner with Clyde Pangborn co-pilot, was winging its way to Australia in the MacRobertson International Race from England to Melbourne in 1934, establishing the superiority of the American type transport plane. The crew stepped out at the finish in fresh uniforms, shaven and untired in contrast to their competitors.

"With the specially built Learadio equipment we used in the MacRobertson Race," says Colonel Roscoe Turner, "we established several world's records for aircraft radio-distance-communication. The equipment worked faultlessly throughout the trip . . . We use Learadio Equipment in our school for Army and Navy Cadet Pilot Training."

Other famous pilots who use Learadio in their planes include: Clyde Pangborn, Major Al Williams, Major Alexander P. deSeversky, and Bob Hall.

Learadio, *the pilot's preference,* is now standard equipment on the better known aircraft including Grumman Amphibians, Wacos, Fairchilds, Cessnas, and most civilian and air cadet pilot training aircraft and itinerant types used in the service of the armed forces.

* * *

Automatic electrical and mechanical controls of Lear-origin are incorporated in aircraft manufactured by: Consolidated, Vultee, North American, Douglas, Boeing, Lockheed, Beech, Curtiss-Wright, Grumman, Northrop, and subcontractors: Ford, General Motors, Bellanca, Eastern, Nash-Kelvinator.

RECEIVER

T-30 RCBB transmitter-receiver is an extremely efficient and dependable 2-way aircraft communication system. It's the *"pilot's preference"* because every flying need has been foreseen and every installation problem solved in advance—everything is at the pilot's finger tips.

- ★ Powerful 2-frequency crystal controlled transmitter (2900 KC to 6500 KC).
- ★ Telephone and telegraph emission approx. 20 watts output.
- ★ Three Band receiver — radio ranges (180 KC to 405 KC) broadcast (500 KC to 1200 KC) airway communications (2800 KC to 6700 KC).

For "three-way radio", the receiver includes new provision for operating from both the conventional antennae and the famous lightweight Learadio loop *(shown below)* providing static-free reception or aural-null direction finding. *(Approved type for C. P. T. training).*

Write for Descriptive Literature
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PIQUA, OHIO

BATTLE-BORN, BATTLE-TESTED, BATTLE-PROVEN

Superior Instruments FOR TOMORROW'S FLYING

POWER UNIT
G-30-AB

It can't be told yet . . . the full story of the amazing job that's being done by the Civil Air Patrol. But when the war is won and the facts can be revealed, another great chapter will have been added to the story of America's conquest of the air.

This chapter will tell how a little group of amateur pilots flew light private planes in impossible weather, with incredible loads, on warlike missions that would have seemed fantastic in peacetime.

And it will tell that many of these planes were powered by Franklin engines, serving under conditions never foreseen by their makers . . . yet still delivering dependable power week in and week out with minimum service and parts replacement.

Aircooled Motors Corporation is proud of the great work done by CAP, and proud too, that its Franklin engines have had some part in making that work possible.

AIRCOOLED MOTORS CORPORATION, Syracuse, N. Y.

Franklin

DESIGNERS AND BUILDERS OF AIRPLANE ENGINES FOR THE ARMY AIR FORCES and BUREAU OF AERONAUTICS, U.S.N.

HEATH

TOMORROW'S AIRCRAFT REFINEMENTS--TODAY

HEATH LIFETIME WINDSHIELD

HEATH PRODUCTS are now serving the Air Forces of America

TO MAKE civilian flying safer, more enjoyable — to increase the performance and life of aircraft — these are the forces behind the development of the many Heath products.

Pilots who take pride in their ships, and instructors seeking maximum efficiency have long since turned to Heath for accessories which give added zest —and security to air training and travel . . . After the war, both will benefit from Heath advancements now devoted to the Nation's Air Forces.

HEATH RADIO

HEATH AIRPHONES

HEATH COMPANY

MANUFACTURERS OF AIRCRAFT COMPONENTS

BENTON HARBOR, MICHIGAN

HEATH LIFETIME TAILWHEEL

AT DEADLINE

by MAX KARANT

IT is a persistent rumor that the Civil Air Patrol may soon be abandoned. If the rumor becomes fact, we will not be surprised. Some time ago we said that, if the CAP did not get a transfusion in the near future, it almost surely would face extinction. Several reasons could be given for the failure of CAP. With the exception of one or two, though, all other reasons would simply be attempts to cloud the issue. The most important reason—the one probably more responsible than anything else—is the CAP itself.

Aside from the coastal patrol units that have done a superb job under the direction of the armed forces—and have demonstrated brilliantly the tremendous value of the private flyer even in time of war—the Civil Air Patrol has been one of the most innocuous organizations of its kind in the United States. Theoretically, at least, it could have been a vitally important air arm on the domestic front. A few individual CAP units—more because of their individual leaders than anything else—did some good work inland. But the vast majority of CAP units operating inland—if they operated at all—have been going nowhere in not too much of a hurry. To put it simply, they have had nothing to do. There are a hundred things they could have been doing, but CAP Washington headquarters either didn't know what those things were, or just plain didn't care. Throughout the United States CAP pilots, planes and ground personnel were indulging in an almost comical struggle to convince themselves they were doing something worthwhile. CAP men and women spent thousands of dollars of their own money trying to keep things going. They flew on "missions" at the request of anyone who wanted them, footing the bills for gas and hangar rent themselves. Nine-tenths of the time those missions might just as well have been a concerted hunt for the cat next door.

* * *

IF U. S. Army, Marine and Navy airmen continue to knock down Jap planes and aircrews at the rate they have been since the war began, it will be a relatively short time until Japan's air power is irreparably crippled. We make this statement taking into consideration the productive capacity of Japan's aircraft industry, whatever it may be.

Several factors will contribute to this crackup. One important one to remember is that all American successes to date have been made with comparatively obsolete equipment: Grumman *Wildcats*, Curtiss *Kittyhawks*, Bell *Airacobras* and so on. The Japs have yet to face numbers of Republic *Thunderbolts*, Navy *Corsairs* and several other types we are not at liberty to mention.

It will be said, of course, that the Japs also have new, deadlier types coming into service. But there are indications that all is not so well with Jap aviation. U. S. airmen have for some time been reporting Jap efforts to overcome serious weaknesses in Nipponese warplanes, but every new Jap type reported in combat to date is inferior to currently-used American types.

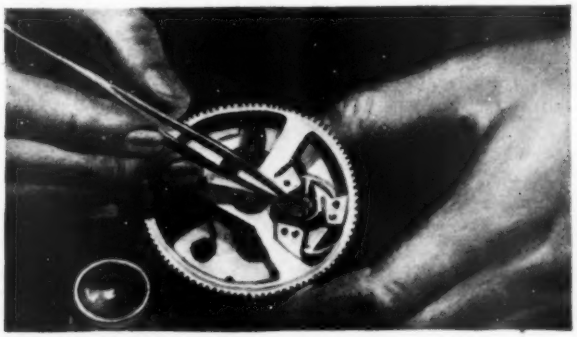
The big thing, of course, is production. The most conservative estimates indicate that Jap aircraft production is one-fifth that of U. S. production, or less. And American production is just hitting its stride. Already estimates in this country are in terms of nearly 10,000 planes a month, or almost 10 times the estimated Jap production.

Reports from the combat zones have definitely established the unquestioned superiority of American flyers. Much of this is due to the training methods and standards of the U. S. Army and Navy. This factor, along with the others discussed here, may well spell the end of Jap military aviation in the not-too-distant future.

(*Continued on page* 141)

"HUNTING JAPS on thousand-mile sweeps of the Pacific sure gives me something to look forward to. When we've finished this job, I'm going to buy a plane and hunt everything from Kodiak bear to Carolina quail. Because I've learned you can *find* where you're going and get back home again—if you're flying with instruments you can depend on—*real precision* instruments like they're putting in these babies."

"I LIKE SPEED, but when I fly I want to *know where* I'm going. That's why I want the best precision instruments I can get—instruments I can trust, no matter how tough the going. Then I can use my plane in all kinds of weather, to go *where* I want, *when* I want. After all, *utility* is what you want in an airplane."



MADE TO TOLERANCES as close as .00001", the moving parts of some Kollsman instruments are so precise and must operate at such temperature extremes that the finest oil is too heavy for them. Hence, the gear pinions are set on jewel bearings to insure almost frictionless operation, with plane vibration replacing lubrication.

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Training the CLIPPER PILOTS

with JACOBS AIRCRAFT Engines

Long before the day when he took the controls of this huge skyliner, the Clipper Pilot served an apprenticeship exacting in the extreme—an apprenticeship of countless hours aloft, under every conceivable condition, flying mostly "on instruments."

This comprehensive training requires Training Planes powered by the most reliable of engines.

Pan American Airways Clipper Pilots—like our Army Bomber Pilots—are schooled in twin-engine Trainers powered by JACOBS.

Pan American Airways Jacobs-powered Cessna.

JACOBS AIRCRAFT ENGINE CO.

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AVIATION'S GREATEST

The Editors of FLYING asked eight of aviation's leading executives the question: "In your opinion, what was the most significant achievement in aviation in 1942?"

LAWRENCE W. BELL
President,
Bell Aircraft Corporation

THE successful assimilation of an army of hitherto untrained women workers into the vast production machine of the nation's aircraft industry, and the similarly successful training of thousands of soldiers to become maintenance and service experts for the many types of combat aircraft are, I believe, achievements which deserve equal credit as most significant in 1942.

At the beginning of the new year, the day is close at hand when at least 50 per cent of all production workers in a typical aircraft plant will be women, and it is probable that this percentage will go even higher. Women in uniform today are doing well the assignments given them, and each day they are managing to perform creditably operations which hitherto were considered exclusively men's work.

It is almost a truism that a grounded airplane is worthless during war. But too few people realize that, except for the training of enlisted personnel as maintenance experts, the value of the aircraft industry's production effort would have been greatly reduced. Under the enlightened direction of Maj. Gen. Walter R. Weaver, head of the Air Forces' Technical Training Command, our aircraft companies have established a successful program which is doing this important teaching job, supplementing the training work efficiently conducted by the United States Army Air Forces.

RALPH S. DAMON
President,
Republic Aviation Corporation

UNQUESTIONABLY the most outstanding achievement in aviation during 1942 was the establishment of the Air Transport Command. When the full story is told the world will gain some conception of the magnitude of the job those men have done and are continuing to do so successfully.

Such outstanding success as enjoyed by the Air Transport Command can be primarily attributed to smart organization. In the minimum of time the Air Transport Command organized operation which only a few years ago were considered "dream stuff." In other words, the Air Transport Command harnessed imagination and American ingenuity to perform a task which at any other time would appear to be nothing short of miraculous. Actually it has transformed the miraculous into the commonplace. Composed of personnel whose capabilities allowed for the acceptance of every mission, the Command has overcome all obstacles to fly a route which is truly global. They moved the Burma Road upstairs. They flew many heroic hours during the evacuation of the Philippines, have been flying the Pacific with almost monotonous regularity and kept the flow of supply to Alaska constant prior to the opening of the Alcan Highway and since. In all the time that this was going on, the Command has successfully carried out all operations over the North and South Atlantic, between the United States, South America, Europe and Africa in an almost routine manner.

The job which the Air Transport Command has done is not only the outstanding achievement in aviation during 1942 but is indicative of the genius, stamina and "know how" of the officers and men who have made this accomplishment possible.

DONALD W. DOUGLAS
President,
Douglas Aircraft Company, Inc.

THE most significant event in aviation in 1942 was formation of the Aircraft War Production Council. Eight of the leading aircraft manufacturers in the United States voluntarily pooled their combined experiences, resources and energies to give America and the Allied Nations the greatest aircraft production the world has ever seen.

Individual interest, competitive ideas, post war markets — all things of pre-war or post-war importance were laid aside. More airplanes and better airplanes became the goal. Production was placed above everything else. Results of this important and unique undertaking began to manifest themselves almost immediately. As 1942 came to a close, this form of individual cooperation registered in increased production, in broken bottlenecks and in speeding up of production lines in America's largest aircraft factories. In 1943 the full effect of the Aircraft War Production Council's program will reach the high tide. I sincerely believe the year will record gains beyond all expectations.

I consider formation of this council the most significant event in aviation because it not only unified the great industry in the performance of a great task but also because it gave a clear demonstration that American industry, functioning under our way of life was equal to the challenge and that Democracy, under pressure and stress of war, can and will achieve victories on the production front.

CLARE L. EGTVEDT
Chairman,
Boeing Aircraft Company

IN a year marked by the rapid transition of America's aerial arm from a defensive force to a positive offensive power, I believe the most significant single achievement has been the introduction of successful daylight bombing both in the Pacific area and over continental Europe by the U. S. Army Air Forces. This type of bombardment operation, undertaken not only in the Far East but over highly defended continental Europe since August, 1942, marks the actual wartime test, and demonstrates the effectiveness of a combination of military ideas and devices developed over a period of years. These include: (1) accurate bombsight equipment to insure effective target bombing from low or high altitude, (2) bombers of unparalleled performance, with ability to evade interception and accurate ground fire by operating at high altitudes, (3) new combinations of armament and armor, permitting these bombers to match or excel the fighting power of pursuit planes, and thus assure completion of their missions.

The combination of these three points has brought bombing out from the cover of darkness and into the daylight. It has, in effect, resulted in a more effective weapon of offense which will speed eventual victory. This departure from former concepts of bombing operation makes it possible to carry heavy bomb loads beyond the range of escorting fighter planes. It assures devastating accuracy when the bombs are unloaded. And it makes possible round-the-clock operations, in conjunction with conventional equipment—a terrifying factor to the enemy.

The type of daylight bombing operation described above has proved thus far to be of tremendous advantage in still another way—it has made it possible for the bombardment mission not only to accomplish its objective on the ground but at the same time to cut down the strength of the enemy in the air by successfully engaging the attacking fighters en route. We of Boeing are grateful that we have been privileged to contribute to this achievement through our airplane, the B-17 *Flying Fortress*.

1942 ACHIEVEMENT

ROBERT E. GROSS

President,
Lockheed Aircraft Corporation

AN outstanding achievement in aviation for 1942 was the rallying of the airlines of the United States to the cause of air transportation at a most difficult and crucial moment—a moment when speed attainable only by the airplane was vital. The airlines threw their might into the gigantic task of the air transport command to keep supply lines moving toward many theaters of war. By the end of 1942 they were flying men, munitions, medical supplies, food and other materials over most the globe and, in addition, they were maintaining regular commercial schedules at home for passengers, mail and express. Within five months after America entered the war the airlines had sent approximately half their domestic transport fleet into the nation's service for Army cargo and personnel requirements. Half remained on the home front. Yet, between January and September of 1942, the number of revenue miles decreased only 12 per cent and the number of passengers carried decreased only 4.7 per cent. Air express shipments more than doubled and despite the sharp reduction in facilities the airlines carried them through. Air mail shipments increased by half. Each airplane is now doing about 90 per cent more work than it did a year ago. It's a tribute to airline management, pilot and servicing personnel and to the equipment used.

W. A. PATTERSON

President,
United Air Lines

THE most significant achievement in air transportation in 1942, in my opinion, has been the tremendous expansion of air transport operations on a global scale. Bypassing the usual pioneering period during which new routes to distant lands are cautiously and thoroughly established before scheduled operations are begun, in cooperation with the Army's Air Transport Command, the airlines of this country overnight began operating long distance routes into far-off places, and thus telescoped the advance of international air transportation by at least 15 years.

Using airplanes originally designed for domestic overland operation on regular airways and blazing new routes without the benefit of modern navigational facilities, the airlines carried out their Army missions with an outstanding record of operating efficiency.

That the Collier Trophy was recently awarded to the Army Air Forces and the airlines is indicative of the importance of the job done jointly by the Army and the airlines in establishing their far-flung system of world wide air transport.

GUY W. VAUGHN

President,
Curtiss-Wright Corporation

WITHOUT a doubt, the most significant achievement in aviation during 1942 was the miracle of design and production achieved by the aviation industry in producing warplanes for all fronts over which we now are engaged.

A survey of this organization's three manufacturing divisions reveals that we now are producing more warplanes, engines and propellers in a single week than we did in an entire year not long ago. It is this tremendous expansion in quantity without sacrificing quality that has overcome in a short period of time the numerical advantage held by the Axis as a result of its years of secret planning and building.

Many individual items might be selected as a "significant achievement," as is the custom in ordinary years, but 1942 was most decidedly not an ordinary year, and therefore an over-all view must be taken of aviation as a whole. Certainly the emergency of aviation as the dominant factor in modern warfare could not be described as an achievement. But the ability of aviation as an American industry to meet the exigencies of a desperate situation most certainly *is* to be considered an achievement. I might cite merely the performance of our own divisions with which I am, of course, most familiar—although our record is duplicated in varying degrees by other components of the industry.

Our Curtiss-Wright Airplane Division (which had doubled its plant area in 1941) again increased its manufacturing area in the east and middle west by 100 per cent during 1942. This division more than doubled its employment in the same period and increased its actual production of airplanes by more than 300 per cent. Our Wright Aeronautical Corporation, assigned one of the heaviest loads in the war industry, likewise carried out a gigantic expansion program in New Jersey and Ohio totaling millions of square feet. Our Curtiss-Wright Propeller Division has developed the greatest production area of any propeller manufacturing company.

Mass production is not just a slogan—an aim to be accomplished—it is a fact.

HARRY WOODHEAD

President,
Consolidated Aircraft Corporation

IT is my belief that when American planes and pilots swung into action during 1942 the main problem was mass production—supplying those pilots with planes. Therefore, the biggest achievement was the expansion of the philosophy of mass production in most of our aircraft plants.

To carry this philosophy to its logical conclusion, I think most aircraft plants ultimately will adopt moving, powered assembly lines. Such a method is particularly adaptable where the volume of one model is large. Eventually we will have utility conveyor lines which can be changed over in a short space of time so that it will not be necessary to have large orders of any one airplane. They will be able to do it on lots of a few hundred. That is a logical development from the achievements of 1942.

At Vultee we first introduced true mass production through the use of powered moving assembly lines. This was thought ideal for small planes, impossible of achievement for such planes as the four-engined, 110-foot winged Liberators, weighing more than 50,000 pounds.

Consolidated last year proved conclusively that it could be done, and in the course of the year production rose 200 per cent with only a nominal increase in employees. Man hours consumed in manufacturing the Liberator were slashed 50 per cent.

Translate to the fighting fronts the achievements of Vultee and Consolidated and other manufacturers with similar production increases. Here you find that where one fighting unit a year ago would have received 10 planes, it is getting 30, and where another a year ago would have received 30 planes, now 90 are being delivered.

Mass production thus carries itself out of the factory into the field, where one more bomber means one more step toward the air supremacy we need. When we achieve victory, it will be due in large measure to the mass production of aircraft, which really got underway during 1942.

Two Consolidated cargo types are the landplane "Liberator Express" and flying boat "Coronado."

LANDPLANES OR FLYING

IN RECENT months, due to the projected manufacture of huge cargo planes, a controversy which has been waging for years has again flared up. The issue is whether landplanes or flying boats are more suitable for carrying cargo. A considerable difference of opinion has resulted.

It is shortsighted to arbitrarily choose either one type or the other. It is unfair to shout the merits of the type chosen and to point up the disadvantages of the other. The practical way to look at it is to weigh the advantages of both types and then to consider them in relation to the operation to be undertaken.

Consolidated's experience with both types of aircraft goes back many years. Today the company produces the *Liberator*, a landplane utilized as a bomber, transport and cargo carrier. It has had extensive experience manufacturing the PBY amphibian. In the flying boat classification, it has the PBY-5 and the PB2Y-3, a four-engined plane slightly larger than the *Liberator*, designed as a transport, cargo carrier and bomber.

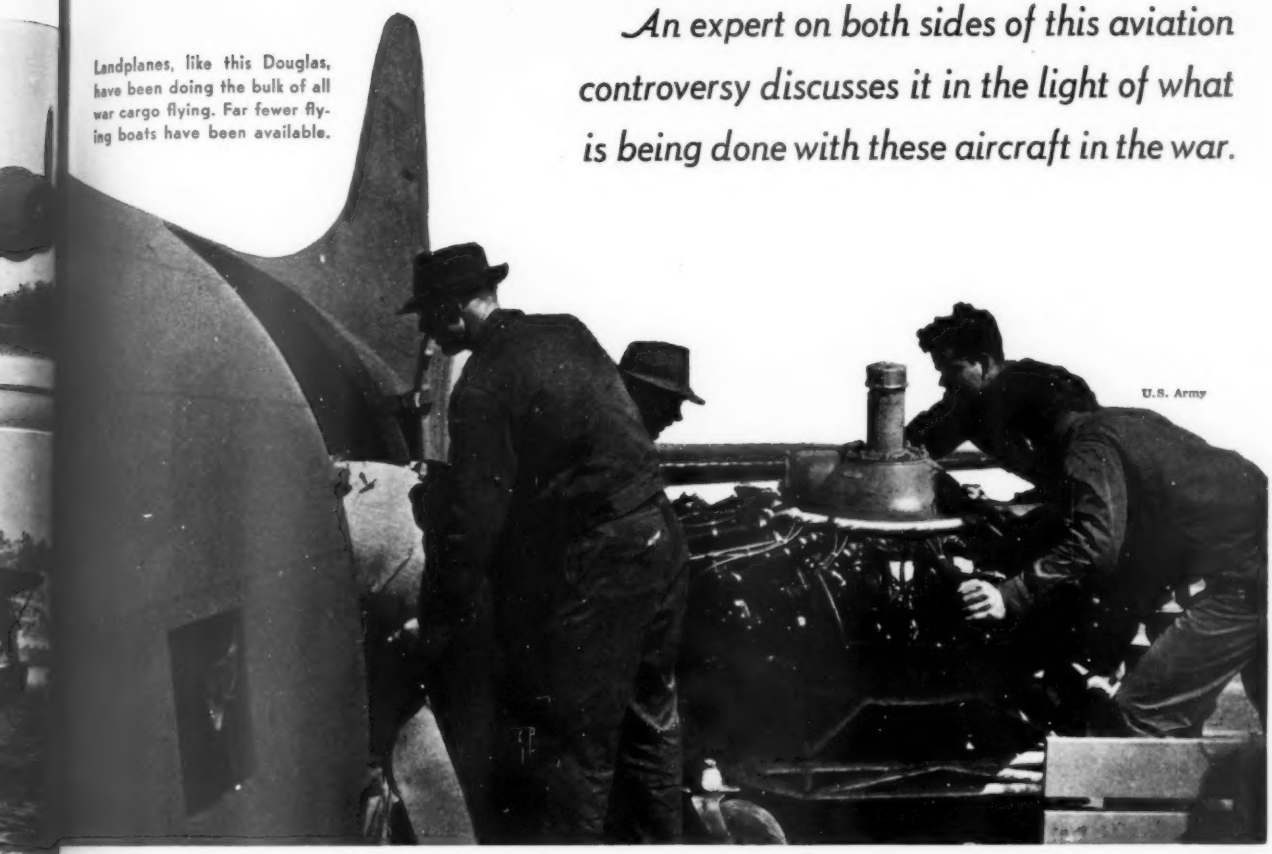
In weighing advantages, the question of reliability of motors can be set aside, since practically all cargo planes, whether land or sea, are now being powered with two or four engines. The reliability of these engines has been proved, as in multi-engined operation there is seldom a failure of all engines. Tests have shown that two-engined planes can be flown with one motor and four-engined planes with two motors under almost all conditions.

For the past few years, in all parts of the world, flying boats have been flown long distances over land, and landplanes have been flown for long distances over water. Consolidated has delivered hundreds of flying boats transcontinentally. On the other hand, flight reports indicate the completion of 995 trips out of 1,000 trans-oceanic flights by landplanes, even in the face of all kinds of weather, operation by flight crews at first inexperienced in this type of operation, and the possibility that some might have been shot down by enemy aircraft. The loss here is one-half of one per cent in the face of these hazards.

Therefore, in the face of proven safe operation by both types of craft, it would be advisable for any operator, government or private, to first study the type of operation planned and then choose the type which best meets the requirements. Once this has been done, the problem has been met.

From an engineering standpoint, it is safe to make the statement that roughly the weight of a flying boat bottom is equal to the weight of the landing gear of a landplane of equivalent size. However, in the case of the flying boat, in order to obtain desired water characteristics, it is necessary to have a certain width, depth and length of hull, the dimensions of which are greater than the comparable dimensions for the equivalent military landplane. This results in a less clean airplane, which of course penalizes the boat's performance. This comparison does *not* hold true, however, for a commercial landplane with a relatively large fuselage.

An expert on both sides of this aviation controversy discusses it in the light of what is being done with these aircraft in the war.



Landplanes, like this Douglas, have been doing the bulk of all war cargo flying. Far fewer flying boats have been available.

U.S. Army

BOATS FOR CARGO?

by THEODORE P. HALL

Now chief production engineer of Consolidated Aircraft Corporation at San Diego, Mr. Hall joined that company in 1931. Born December 18, 1898, in Wallingford, Conn., he attended Syracuse University and the Massachusetts Institute of Technology. He was a designer for the old Thomas-Morse Aircraft Co., later was research engineer for Cunningham-Hall Aircraft.

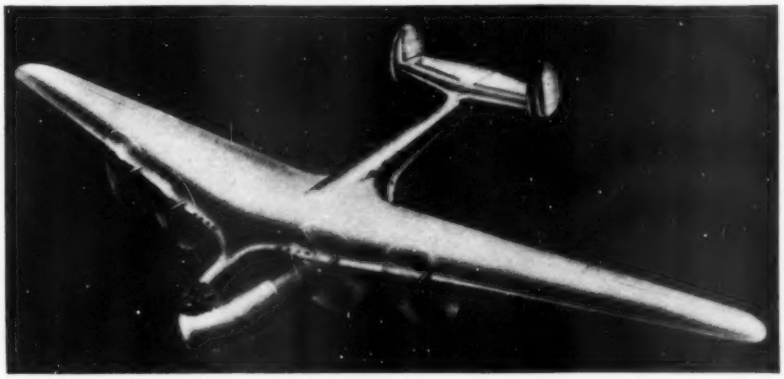
Economy of construction must be considered in choosing between the two types. Methods of construction are just about the same, save for the differences which exist between landing gear and hull. Weight comparison of the flying boat and military landplane capable of the same range shows the boat to be about 20 per cent heavier than the landplane. Added weight means the use of more materials, with more labor involved, and hence added cost to the purchaser. For both types of plane the cost is about the same for fabrication, figured on a per pound basis.

The larger hull of the flying boat results in slower speed than that of the comparable military landplane. As to operation, because the boat is slower it will make fewer trips over a scheduled route. It will require more gasoline to propel it. This means a greater cost to the operator making use of the flying boat.

This is the greatest difference in expense. Rate of depreciation is just about

(*Continued on page* 124)

This giant flying boat design was submitted in 1938 to a Pan American Airways committee.



WAR IN THE AIR

Acme

Two American airmen in the shade of a B-17 wing in New Guinea. One is cleaning .50 caliber gun. Note bomb fins in foreground.

On every front on earth aircraft continue their growing role of devastation. Some of the most spectacular war photographs in history are being produced daily by the air warfare raging everywhere. These pictures illustrate clearly the vast range and scope of the military airplane. As spring approaches many more warplanes are going into operation, with Allied production already well ahead of the Axis.

Sovfoto

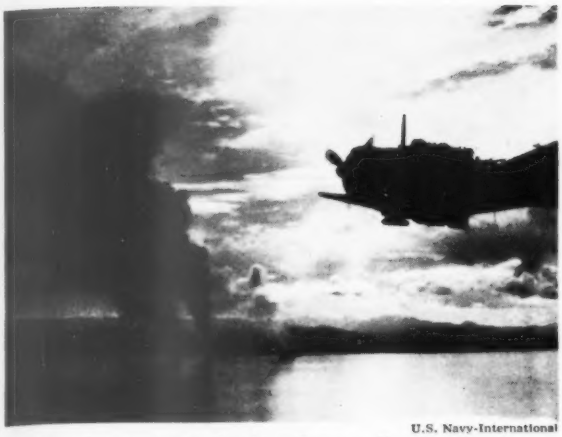
These Russian aircraft workmen are installing a light cannon in the wing of an I-26 single-seat interceptor fighter.

While strafing an objective in France, this Douglas "Boston" hit a steel mast and took four feet of it back to England.

Acme

More than 400 German aircraft, shot down over England, are in this junk heap. Metal is melted and used in RAF planes.

British Combine

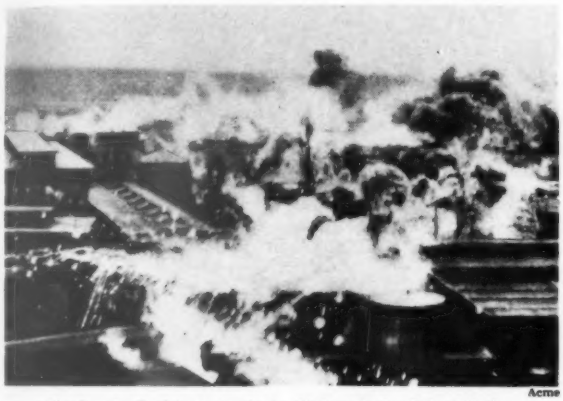


U.S. Navy-International

Four Jap transports already in flames, a Douglas "Dauntless" roams off Guadalcanal seeking other enemy shipping.

International

Softening the Axis for the ground troops, a flight of Consolidated "Liberators" leave for a Mediterranean mission.



Acme

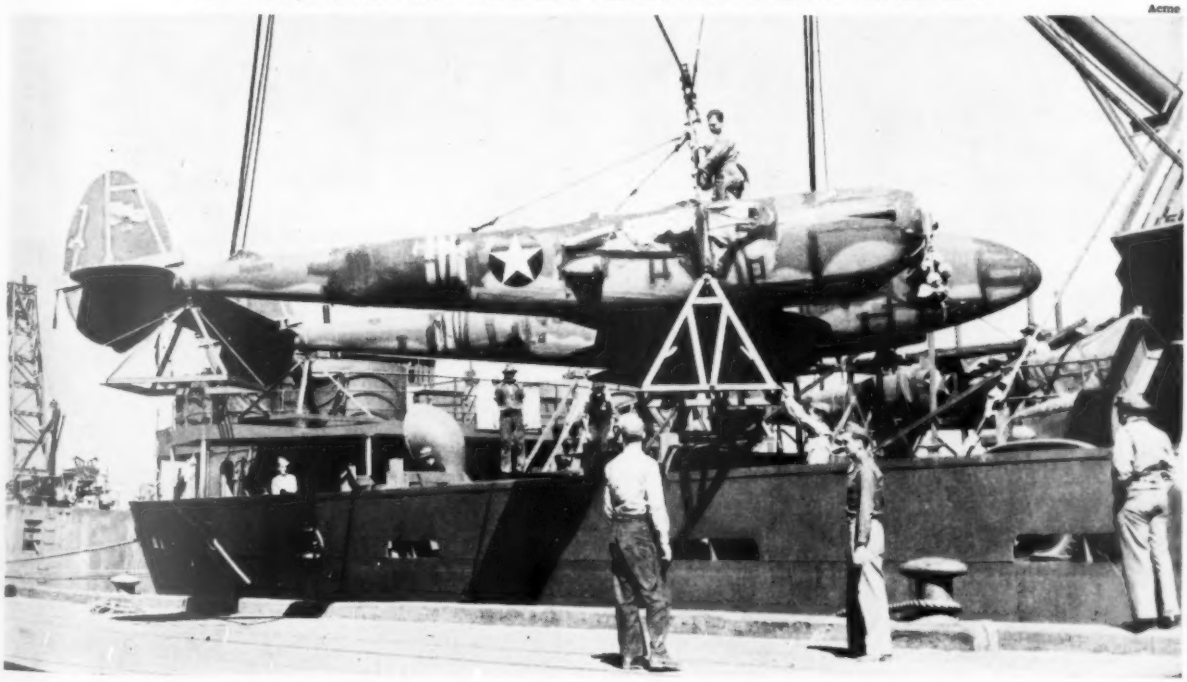
The bombs had just struck the Philips Radio Tube Works as a light RAF bomber swooped in for this photograph.

British Combine

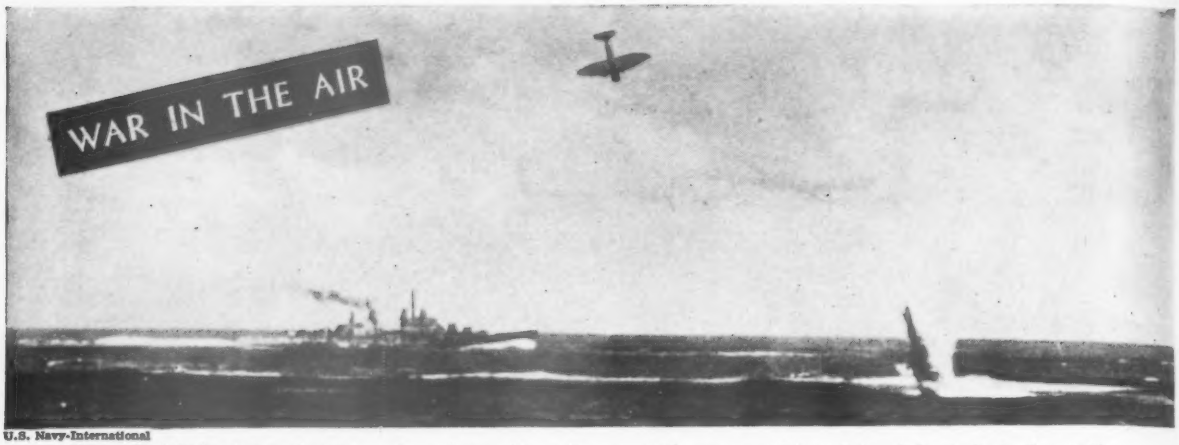
As his machine guns blazed away, an RAF pilot's wing camera made this photo of his destroying an Italian Cant Z-506B.

Sealed for protection against salt water corrosion, this Lockheed "Lightning" is being unloaded from a transport's deck cradle. Assembled in Australia, P-38's are flown to advanced fields.

Acme

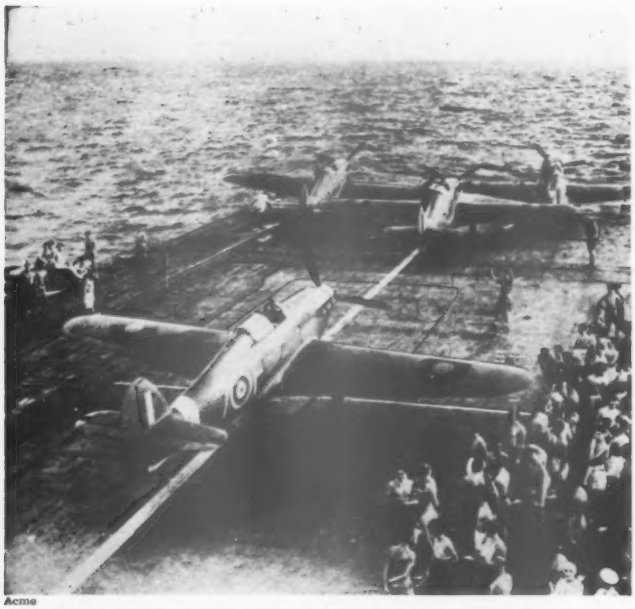


WAR IN THE AIR



U.S. Navy-International

Jap Aichi K-99 has just crashed into water and second is on its way. Both were caught by antiaircraft fire in Santa Cruz battle.



Acme

"Hurricanes" pull to end of carrier's landing area, leaving the runway clear for following planes. Note summer garb on personnel.

Acme

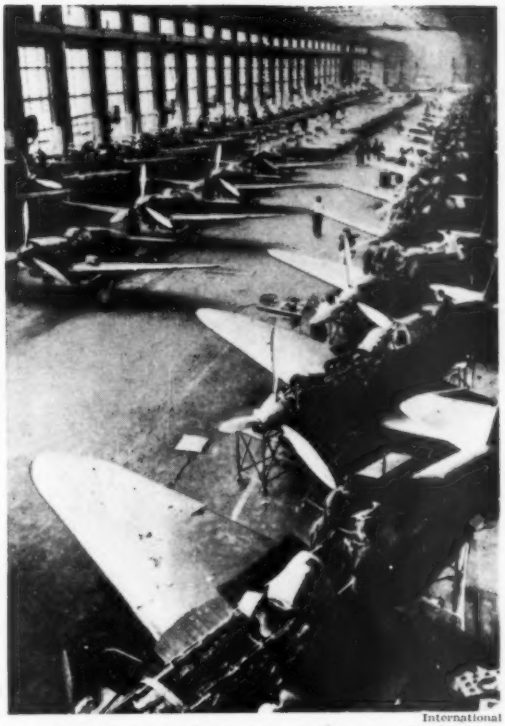
Brig. Gen. V. H. Stahm (right) does not seem perturbed as he and aide examine a German bombsight captured in Libya.

Allied air attack on La Senia airport (Oran, Algeria) destroyed these French Potez fighter-bombers, caught on ground.

Acme

Acme

Despite severed cables, a wrecked aileron and 200 bullet holes, this B-24 "Liberator" flew 1,000 miles to base after a raid over Benghasi.



International

Russia has released this picture showing assembly line construction of YAK 1-26 single-seat interceptors.

U.S. Navy-International

Taking antiaircraft fire from two U. S. cruisers, a Jap pilot points his Nakajima torpedo plane at a third American ship.

U.S. Signal Corps-Acme

Uses of the B-24 never seem to cease. This bomber, junked in the Aleutians, became a control tower and salvage pile.

Valuable stores go up in flames as 10 RAF bombs blast the railroad yards at Mandalay in Burma.

Acme

ACES FOR CHINA

by GEORGE H. COPELAND

U. S. Army instructors are making China's air force into a deadly aerial spear pointed at the Japanese.

THE Japs in China who now find tough going against General Stilwell's "Sky Dragons" will soon have to contend with another group that may be even tougher—the young Chinese flyers who have been training under American instructors in southern Arizona. These men, the pick of Generalissimo Chiang Kai-shek's armed forces, came here from half way around the globe to learn better methods of knocking off more Japs. I visited them in training at Luke Field and talked with their American commanding officer, Maj. C. J. Kanaga.

Most of these young aviators had served nearly two years in China's flying forces before they came to America, but they flew and fought under tremendous handicaps. Their airfield was 7,000 feet up, at the eastern end of the Burma Road and back in the mountains where air currents were treacherous and emergency landing fields few. They were always greatly outnumbered by Jap flyers, hence had to carry out their missions in stormy weather while the enemy hugged the ground.

So, in spite of months of service under combat conditions, most of the Chinese had actually chalked up only about 100 hours in the air. To get more flying under better conditions, a chance to practice maneuvers undisturbed, to study navigation, English, meteorology, bombing—all the latest methods of operation with modern equipment—they came to the U. S.

When on combat duty in China the flyers used Russian planes, mostly two-engined light S-bombers. These ships,

An Army Vultee "Valiant" basic trainer is standard for secondary instruction.

Julian Swope

the students told me, "answered all the elementary requirements of combat, and their speed and maneuverability were quite satisfactory." However, since arriving in the United States, the Chinese cadets have found that American planes are all they expected them to be.

The cadets, on their arrival in the United States, are assigned to the same types used by American students. These are the Stearmans for primary training at Thunderbird Field; Vultees for basic training at Williams Field; and North Americans for advanced training at Luke. These training centers are grouped in the southwest.

At primary ground school, the Chinese lads have courses in the theory of flight, airplane structure and design, engines, and technical English including flying expressions. They use books printed in English. In basic training they tackle meteorology, navigation, plane armament, gunnery, start work with the Link Trainer, and begin night flying. The advanced school brings more of the same, plus tactics, cross-country, flying by instruments, and gunnery from a plane. They get a total of about 200 hours in the air in the three schools.

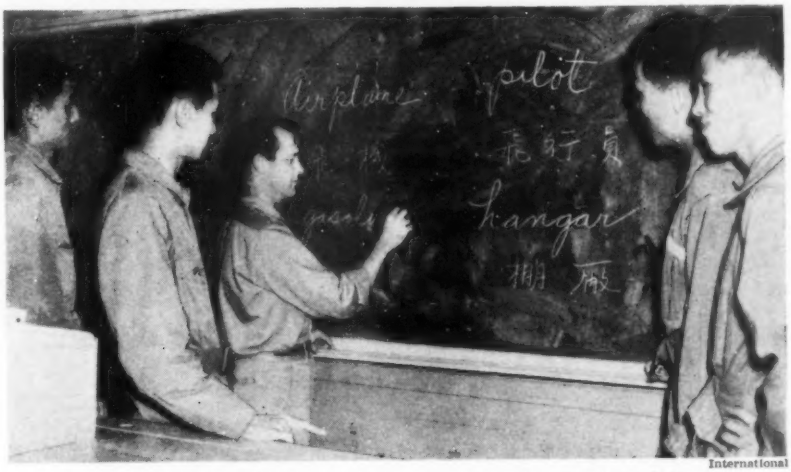
Recently a cross-country flight, starting from Luke Field, almost brought trouble. A Chinese cadet lost his way above the mountains west of Phoenix and had to make an emergency landing near Kingman, Ariz. The sheriff of that town watched him land and when he saw the oriental face appearing out of the cockpit thought the Japs had started an invasion and drew his gun! Identification papers, quickly produced, prevented a possible tragedy.

The first class won their wings in about 20 weeks, whereas the ordinary American

(*Continued on page* 114)

John Swope

A Vultee Valiant stands ready for these cadets at Arizona's Thunderbird Field.

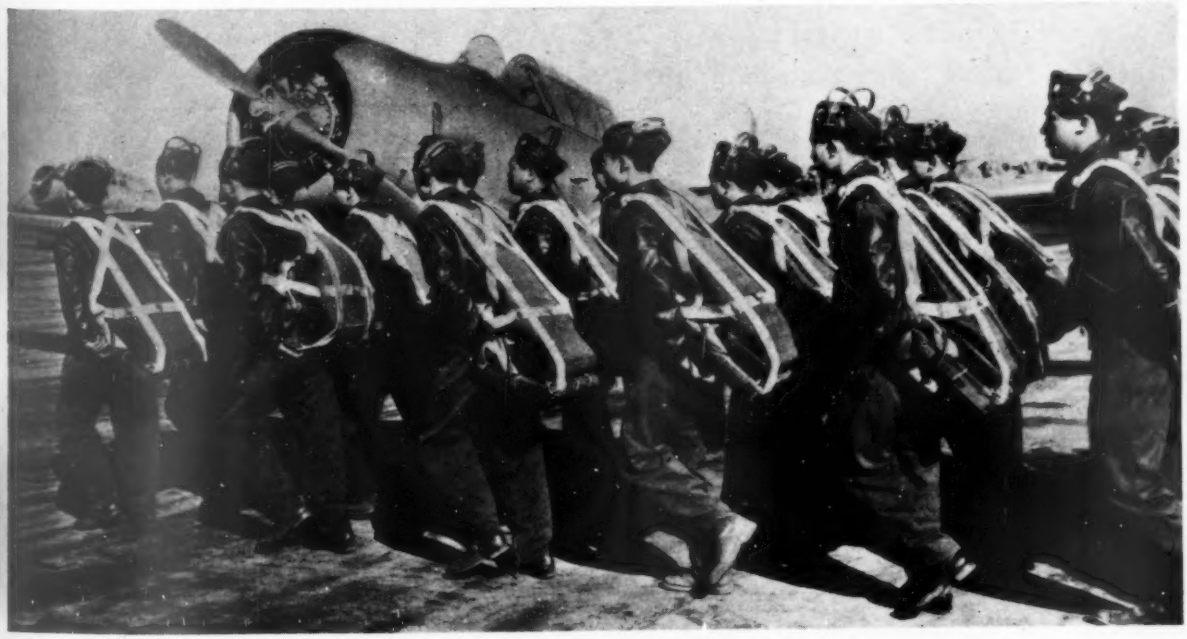


International

A daily class in English stresses the glossary of American aerial vocabulary.

Part of the Chinese cadet's 200-hour air time is logged in North American "Texans" (AT-6A).

Wide World



THE HURRICANE

British Information Service

Now used in the African desert is the "Hurricane IIC," with cannon, long-range tanks and tropical air filter.

by

Sir FRANK SPENCER SPRIGGS

Still a standby of the Royal Air Force, the Hawker "Hurricane" is one of the outstanding United Nations fighting planes in this war.

Chief of the Hawker-Siddeley group of companies, Sir Frank Spencer Spriggs, at 48, can claim 30 years experience in aircraft manufacturing. At 18, he entered the Sopwith Aviation Co., leaving in 1920 for Hawker Aircraft, Ltd. Still holding the latter position, Sir Frank is also president of the Society of British Aircraft Constructors, Ltd. He has written many articles on the development of military and civil aircraft.

EVEN at the present time and despite its achievements, it is doubtful whether the merits of Britain's famous *Hurricane* have been fully appreciated.

The original design of the aircraft dates back to 1933, and it speaks volumes for its merits that 10 years later the type and its many variants are still numbered among the first line of RAF equipment and are rendering yeoman service in all parts of the world.

The Hawker *Hurricane* is really in a direct line of descent from (firstly) Sopwith and (secondly) Hawker products over a period of years, commencing in 1910. It was the first monoplane fighter type to go into production in Great Britain and the first to be embodied in the RAF

It was conceived following the *Fury* biplane, a Hawker product of 1930. In those days, when a speed of 220 m.p.h. was regarded as approaching the ultimate, it became obvious that any increase was possible only with the monoplane type, and a design was developed called the *Fury*. Originally it was intended to accommodate the 660 h.p. Rolls-Royce *Goshawk* steam-cooled engine, and the ammunition comprised four guns, housed in the fuselage and firing through the propeller disc.

Before this project materialized as an actual constructive type, the desirability of incorporating a retractable undercarriage was realized, and in 1934 a new Air Ministry specification was drawn up, based upon the development of the original *Fury* monoplane but incorporating a later and more powerful type of engine, the 1,025 h.p. Rolls-Royce *Merlin C*.

The Hawker design staff, under Sydney Camm, decided to utilize the form of construction which had proved so successful in earlier Hawker types, and the wisdom of this decision became apparent during the following years when production materialized ahead of that of any other similar type.

By November, 1935, the prototype was ready for trial and flights carried out by P. W. S. Bulman proved immediately satisfactory. The armament had been increased to eight .303 guns, four mounted in each wing, so as to clear the propeller disc and increase the rate of fire

On this prototype, as on the earlier production machines, the wings were fabric-covered. Since the early series the

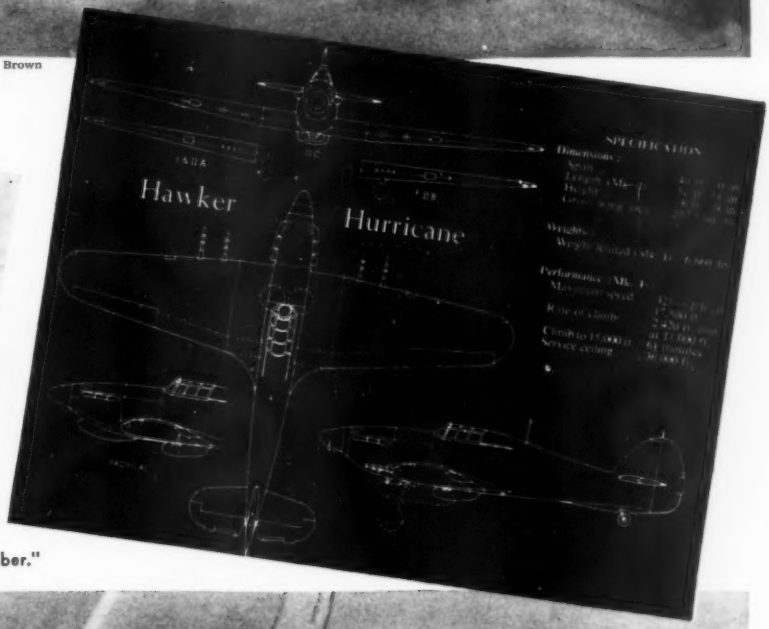
(*Continued on page* 120)

Charles E. Brown

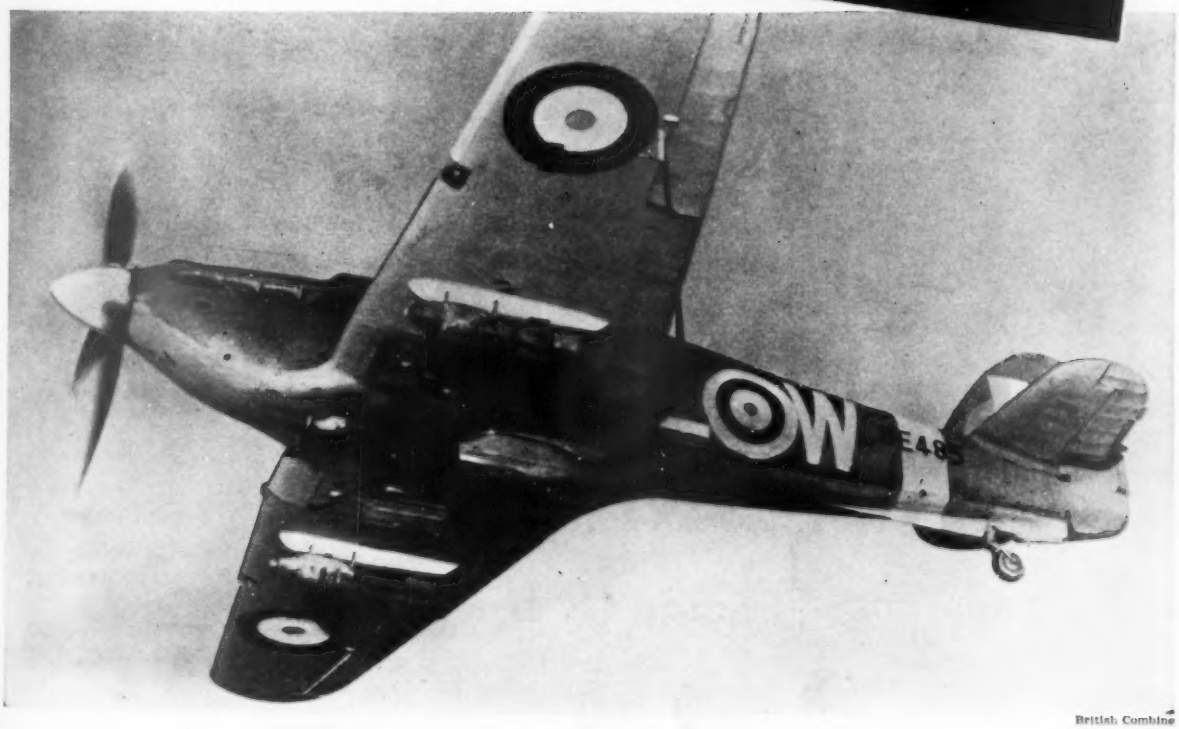
The "Hurricane" prototype first flew in 1933.

Ministry of Information

A "Catafighter" on a British cargo ship.



This bomb-carrying version is called the "Hurribomber."



British Combine

ENGINES

Twin-engined Lockheed "Lightning" has turbosuperchargers for high altitudes.

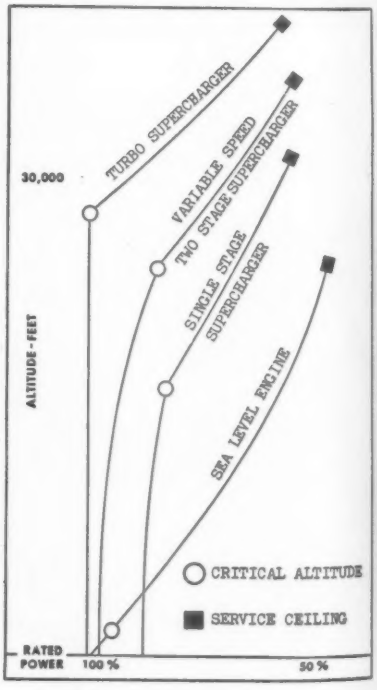
WIDESPREAD and frequent criticism of American fighting planes has generated considerable heat from time to time since the war began—but not much light.

Recently, the Allison Division of General Motors Corporation, which produces the Allison liquid-cooled aircraft engine used in several types of fighter planes, decided that something should be done to furnish the missing illumination on the subject. Accordingly, it prepared a paper in clear non-technical language on some of the fundamentals of aircraft engine design and showed how they affect the performance of airplanes.

Herewith is a condensed version of the 48-page document:

An example of the inaccuracies which frequently reach the public with regard to aviation is the statement that more horsepower is required to fly at high altitudes. Actually the reverse is true because of fundamental physical laws which assert themselves as soon as the airplane leaves the surface of the earth. These same fundamentals, however, affect engine horsepower, resulting in a decrease in power which, unless something is done to counteract it, occurs more rapidly than the decrease in resistance to the plane flight.

Relative altitudes of an airplane with same engine but varying supercharging.



AND ALTITUDE

by REX SYDNEY

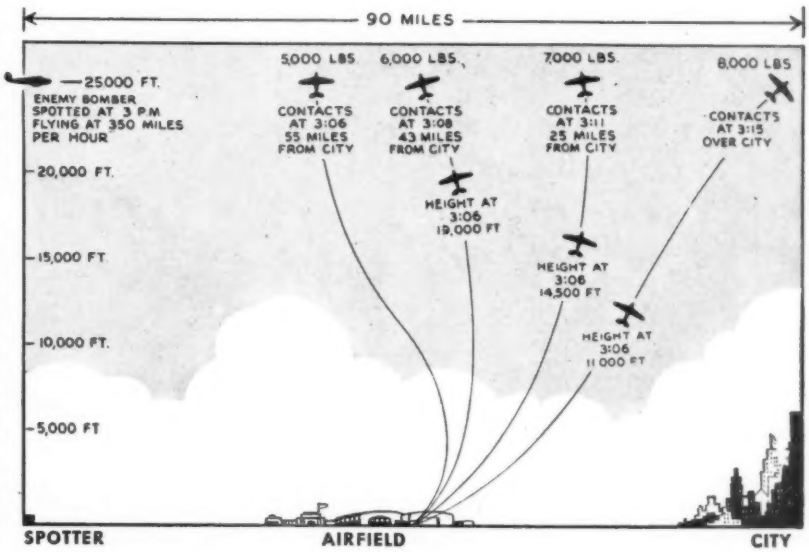
Few people—even in aviation—know what they are talking about when they discuss the modern aircraft engine. Here are some helpful facts.

Perhaps the most influential single factor among the fundamentals governing aircraft engine operation is that of the density of air. This decreases, of course, as the aircraft ascends and because the power developed by such engines is "directly proportional to the amount of air we can get into the cylinders"—it takes about 14 pounds of air mixed with a pound of gasoline for so-called complete combustion—airplane engines must be equipped with superchargers. These are simply centrifugal fan-type air pumps run at very high speed which are geared to force air into the engine cylinders constantly at sea-level pressure.

The Allison engineers pointed out that in addition to the fundamentals affecting aircraft engines and the flight characteristics of any given airplane, the special service which a military plane is intended to perform governs to a large extent the specifications upon which the plane is built. For example, the primary mission of the plane determines how much armor it will carry, how many guns, its cruising range, speed, climb and maneuverability.

"No single design can be superior in all the required qualities of the military airplane," the paper said, "and consequently the ship's design starts only after the military strategists have determined what particular type of military mission the airplane is to perform."

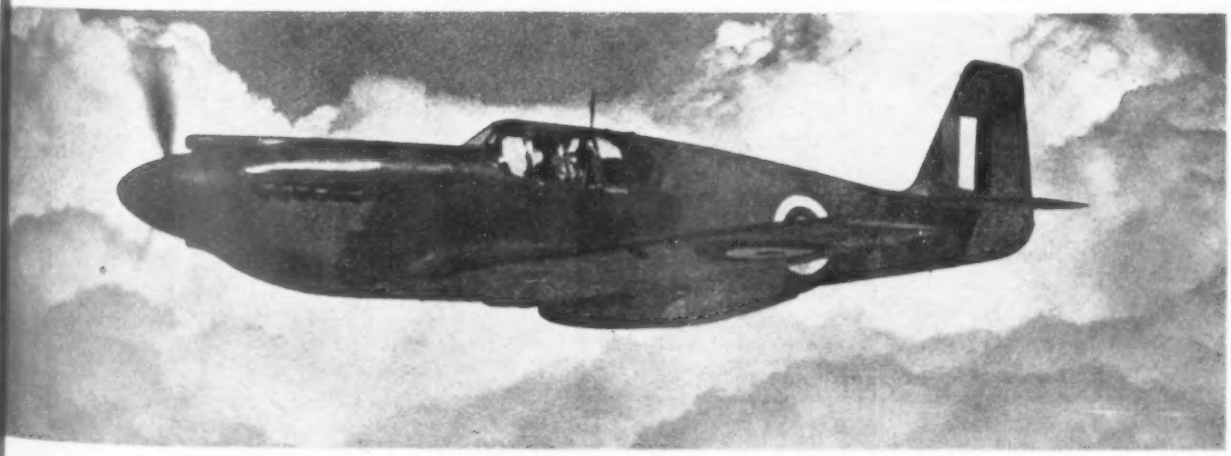
Because the factors affecting airplane performance at varying altitudes seemed to have been one of the principal stumbling blocks of persons honestly seeking to evaluate American combat planes in comparison to those of our allies and enemies, the Allison paper dealt particularly with the auxiliary engine equipment such as superchargers and characteristics involved in the altitude performance of planes.



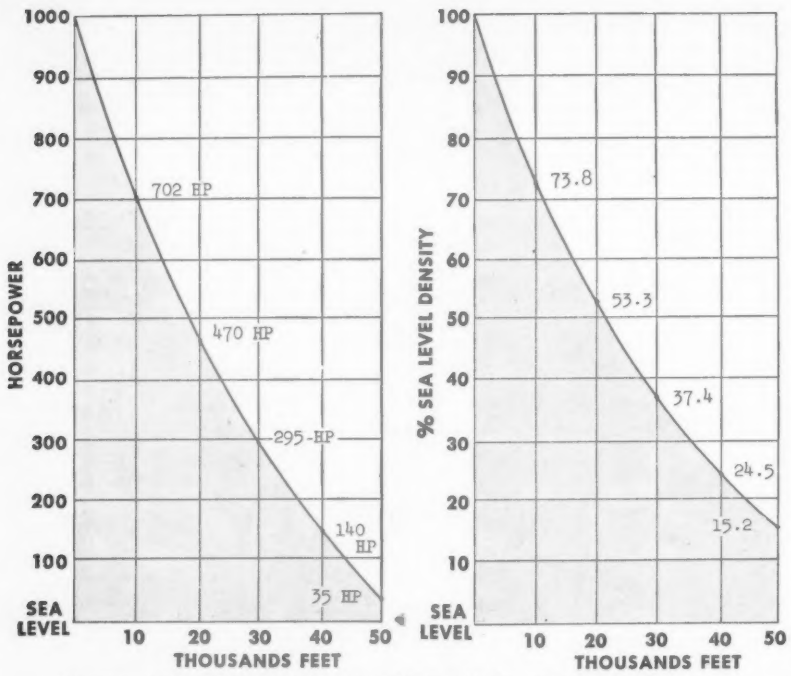
Rate of climb of interceptor fighters, using identical engines but varying in gross weight, is shown in this chart. The lighter plane would climb and maneuver faster.

Illustrating what happens to engine performance if the sea level weight of air is not supplied to the cylinders as the plane rises, the paper showed that the engine which delivers 1,000 h.p. at sea level will produce 35 h.p. at 50,000 feet.

As a result of the temperature change and the decrease in back pressure on exhaust fumes which come from increased altitude, the engine would produce more power if it could get air at sea-level pressure plus the proper pro-



North American "Mustang" was designed for low-altitude fighting, is supercharged accordingly.



Horsepower of an aircraft engine that delivers 1,000 h.p. at sea level will drop to 35 h.p. at 50,000 ft., due to insufficient weight of air delivered to the cylinders.

portion of fuel. That's where superchargers come in.

There are eight methods of supercharging which can be said to have important differences, and each of them has its particular advantages. The methods are: 1, sea level; 2, single-speed, single-stage; 3, two-speed, single-stage, mechanical clutch; 4, variable-speed, single-stage, hydraulic clutch; 5, two-stage with mechanical clutch; 6, two-stage with hydraulic clutch; 7, two-stage with hydraulic clutch and intercooling, and 8, turbosupercharger with intercooling.

All high horsepower aircraft engines, whether sea level or altitude, have superchargers. The sea level engine, however, has a supercharger with only sufficient capacity to provide enough air for the engine to develop the horsepower rating determined for it at sea level. While it involves the minimum sacrifice of weight and space, its use results in lower horsepower as the plane climbs above sea level.

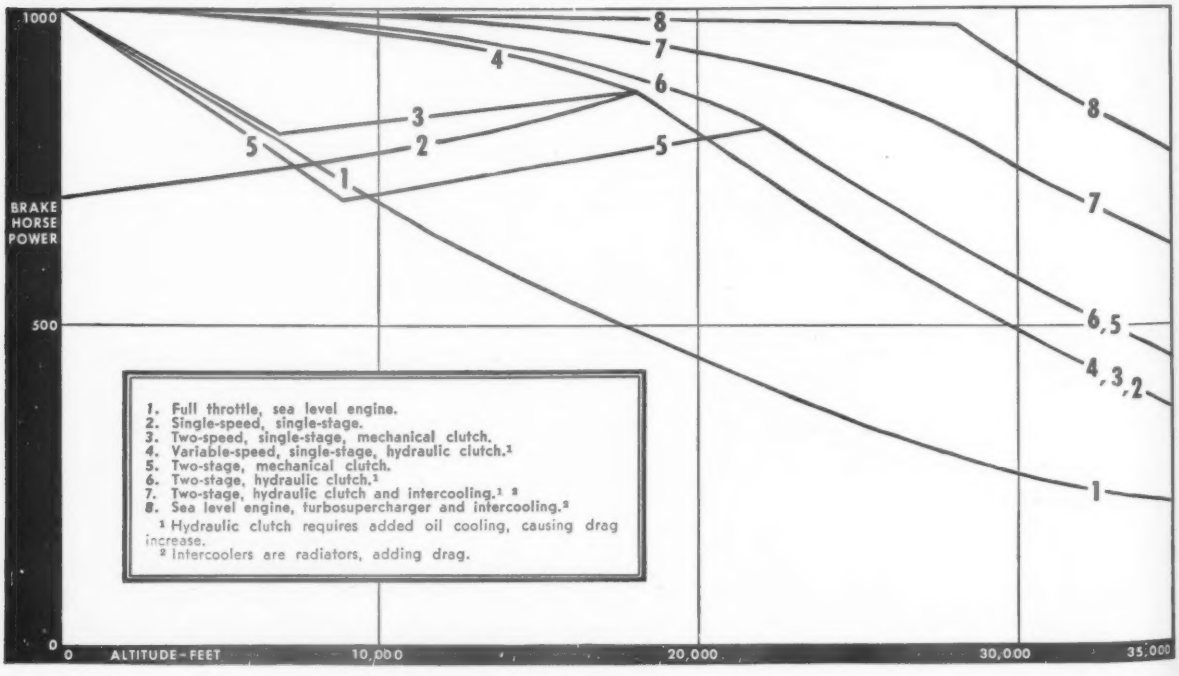
The same supercharger as was used for the sea level engine can be speeded up to deliver sufficient air for an engine whose maximum horsepower is required at 17,500 feet altitude. However, to do so would take more horsepower than was permitted in determining the sea level rating and this must be deducted from the power that was previously available for driving the plane. On the other hand, the engine thus supercharged (single - speed, single-stage) would develop 1,600 to 1,700 h.p. if the throttle is opened fully at sea level, instead of the 1,000 h.p. for the sea level type of supercharger. Full use of that power at sea level might easily damage the engine. Furthermore, at sea level, the temperature of the air being fed into the engine would be increased by compression (due to supercharging) with resulting adverse effects.

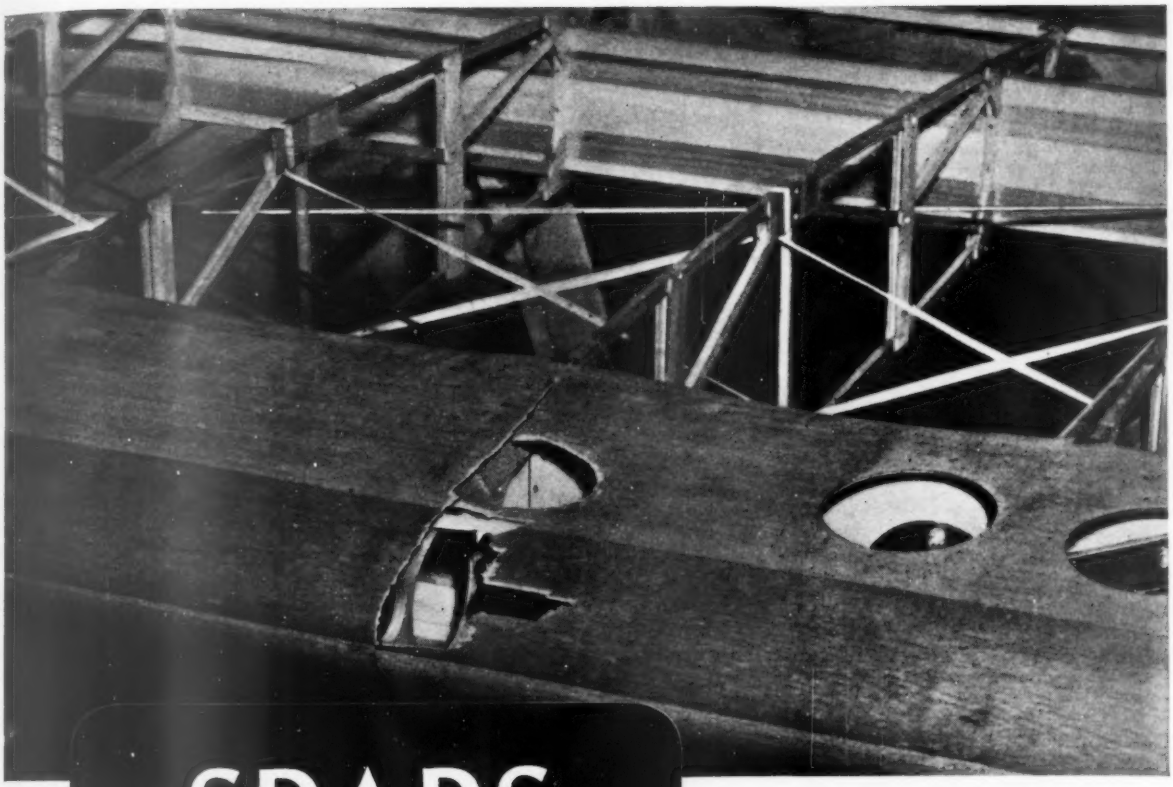
Use of the single-speed, single-stage supercharger as outlined would result in loss of power for take-off and for the first few thousand feet of climb. There would then be a gradual increase in the power above the net power permitted at sea level. This form of supercharger is the simplest, lightest and most compact form of supercharger. It can be effectively used for light airplanes in which loss of power at take-off is not too important up to critical altitudes of approximately 20,000 feet.

The two-speed, single-stage supercharger with mechanical clutch may be driven at low speed at low levels so as

(*Continued on page* 80)

THIS CHART SHOWS WHAT A 1,000 H.P. ENGINE (SEA LEVEL) CAN DO AT ALTITUDE WITH VARIOUS SUPERCHARGERS





SPARS BY RADIO

by GEORGE R. REISS

Unsuccessful in overloading a wing panel of laminated wood, engineers made breaks to study strains.

Laminated wooden spars for lightplanes are being welded through an engineering process using radio.

THEY'RE now using radio—the same kind of radio that helps guide you safely around the airport in thick weather or sends out to you those entertaining musical programs—to help solve America's acute aircraft wood shortage problem.

A radio broadcasting station, diverted from its regular job of dishing out music, speeches, news and commercials, is stitching together, with its beams, pieces of wood to form good, strong wood wing spars for training and liaison airplanes, eliminating a serious bottleneck of the lightplane industry.

Yes, a genuine radio broadcasting station, complete with all its equipment, an assigned set of call letters, with a radio operator in charge.

And the important result of the invention that made this possible is that, instead of only one per cent of America's supply of aircraft wood being available for wing spars, about 30 to 40 per cent now becomes available; instead of only a handful of specially trained saw mill workers (with special equipment) being available to saw spars, the whole lumbering industry can do the job.

And America gets stronger, safer, cheaper airplanes.

This spar-making radio station, a $60,000 10-kilowatt apparatus which is more powerful than most commercial broadcasters, has been installed by the Tolerton Lumber Company, of Alliance, O. (which specializes in aircraft woods), in a dusty corner of its rambling wooden planing mill. Assigned call letters W8SRS, it is operated by Glenn L. Dallas.

It puts out a series of daily broadcasts, but its signals never come out on Ohio radio receivers as speeches, news or music. They merely go slicing through piles of wood to make good firm laminated spars, which some day will carry an army ship aloft.

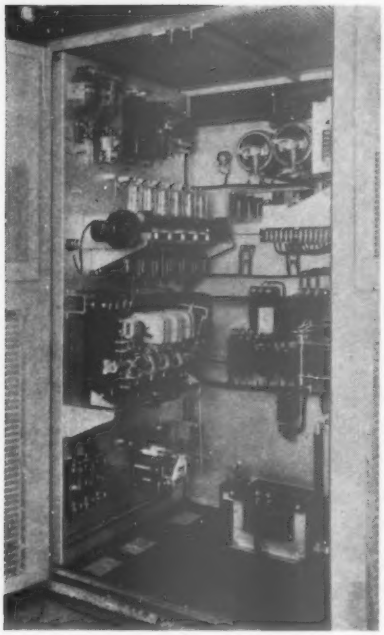
Here, briefly, is how it works:

Workers in the Tolerton plant sort out many pieces of good poplar wood, each about six or seven inches wide and three quarters of an inch thick. Some pieces are 15 or 16 feet in length, others are only two or three or four feet long, but these short pieces are taper-cut with other short pieces, similarly taper-cut to form long pieces. Each is carefully inspected for defects.

Nine thicknesses of the wood are piled up, one on the other, with a layer of glue—either resin or casein glue—between the layers. The wood then is put into a heavy press which draws it up tight.

Electrical connections are fastened to the wood; and here is where the radio comes in.

Unlike heat or cold, radio signals have great penetrating power. That is the reason you can sit in your comfortable air-conditioned home, listening to your favorite radio program, while a blizzard



Interior of RCA-15 frequency generator used to laminate spars by radio waves.

As in ordinary radio sets, wood press is "tuned in" to insure proper "reception."

rages outside. The radio waves easily penetrate the wood or brick or steel sides, the insulating material and the plaster of your home, which keep out the outside heat or cold; and just so, these radio waves penetrate the thicknesses of wood which are about to become wing spars.

But in this case, the signals are slightly distorted. Radio waves, so distorted, would cause an annoying racket in your radio receiver; and in these layers of wood, the distorted signals clash inside the wood, setting up friction which causes heat within the wood. This inside heat dries the glue evenly, firmly and permanently within 10 or 15 minutes, leaving the wood's natural moisture of nine to 12 per cent undisturbed. Thus, the wood is not warped or damaged otherwise.

By ordinary methods of laminating (by using outside heat) the wood doesn't absorb the heat so thoroughly, so that the glue often does not dry evenly, the natural moisture is drawn out by the heat and the wood sometimes warps. Thus, the glued joints sometimes do not hold firmly. And it takes 24 to 48 hours to dry a piece this way.

Once the radio has done its work, the Tolerton workers extract the heavy chunk of wood from the press, saw it into a number of spars counterwise to the way the layers were glued together. This gives each spar the nine layers of wood, with the desired edge grain which adds greatly to its strength.

Executives of the lumber company explain there no longer is a problem of getting enough good wood for spars, but one now of supplying all the demand from various aircraft makers — Taylorcraft, Piper, Aeronca and others—for the new type of laminated spars.

For these new laminated spars solve one of the most vexing problems that had confronted both the light aircraft and the lumbering industries. They had always had problems in getting plentiful supplies of the right kind of solid spars and the war greatly accented this problem—until the radio method of laminating them came along.

Each wing needs two good spars, magnificent pieces of lumber. For light ships, the spars must be 15 to 18 feet long, three-quarters to one inch thick, and five to seven inches wide.

The spars had to be pieces entirely free of knots or blemishes, with the grain exactly right. Only about one piece out of 100 of aircraft spruce was suitable for spars and only a select few lumber men knew how to cut them to suit the airplane makers. These sawyers generally cut the spruce logs with edge grain or quartered them; that is, cut them from the center outward. That gave the spars added strength but wasted much of the log.

Most ordinary saw mills merely take a tree trunk, trim off the bark and slice the log into as many panels as possible, regardless of the grain. This is the most economical way of sawing wood—but not of making spars.

Thus spars were quite expensive, but the lightplane industry got along until the war came, booming the demand for planes, especially wood-winged planes.

Among those most affected were Taylorcraft Aviation Corporation, of Alliance, O., builder of Taylorcraft planes; Piper Aircraft Corporation, at Lock Haven, Pa., builder of *Cubs;* Aeronca Aircraft Corporation at Middletown, O., as well as the companies making Luscombe, Culver, Porterfield, Interstate and others.

Taylorcraft turned to using aluminum spars for its Army jobs. Then aluminum became even more critical than spruce. Taylorcraft, along with the others, was up against it.

But Taylorcraft's chief engineer, Robert H. Wendt, wouldn't be downed too easily. He took the problem to the Tolerton company which had been furnishing wood for many lightplane makers.

"Maybe now," he suggested, hopefully, "laminated spars might do the trick. . . ."

Tolerton executives agreed they might be able to do something in the emergency with laminated spars. Now, there is nothing exactly new about laminating wood, building up layers of wood and gluing them together to form larger pieces. Airplane propellers have been made that way for years; so has been plywood and many other useful wood articles.

But not so with spars. Efforts to laminate them always have been without much success in the past. Civil Aeronautics Administration regulations gov-

(*Continued on page* 147)

This Taylorcraft wing, made with laminated wood spars, took a load of 8,000 pounds. Failing point of wings of this type made with regular wood is around 5,750 pounds.

First flight of the Army C-69 was around the field with wheels down.

CONSTELLATION

by PAUL PIERCE

Photographs from Lockheed

Military air cargo will go faster and higher, now that this new substratosphere giant has gone into production. Original specifications were from TWA.

THE first of tomorrow's airplanes flew today! As we write this, a few minutes after one p.m. on test-flight day, the world's largest, fastest, and most powerful land-based transport, the Lockheed *Constellation*, is buzzing the airport for the benefit of the newsreel cameras. Such playfulness, less than 10 minutes after the first take-off of the new sky-giant, means that famed test pilot Eddie Allen, and Lockheed's Milo Burcham as co-pilot, must find the huge ship easy to fly.

High-ranking officers are all smiles as they watch because the *Constellation* holds a mighty promise for our war transportation system. Built originally for TWA as a luxury airliner, it has been turned over to the Army where it will fly troops and equipment above the weather, over Great Circle courses to all parts of the world. It promises the heaviest load, flown over the longest distance, in the shortest time with the greatest safety and the least cost.

At a top speed comparable with the cruising speed of fighter planes it will fly a light tank and its complement of men across an ocean. Faster than the Japanese Zero or any four-engined bomber now in service, the *Constellation* will cross the continent in less than nine hours or fly to Honolulu in twelve. Powered by four 2,000 h.p. Wright *Cyclone* 18's, the big ship brings fantastic performance to the cargo and transport field. At about half power, cruising at approximately 100 m.p.h. faster than today's airliners, its four great engines drink only one gallon of gas per hour and this economy, coupled with great gas capacity, eliminates refueling stops. No airplane in the world approaches the combination of speed, carrying capacity and economy found in the *Constellation*, and practical airline men prophesy a great commercial future for the ship after its all-important military work is done.

(*Continued on page* 126)

Three-finned tail of "Constellation" holds down over-all height of entire tail unit.

SAFETY SLEUTHS

Their job is to find out why, no matter how long or how arduous the assignment.

by SANFORD S. LITTLE

AMERICAN aviation has grown measurably safer because of a small group of men who for years have worked unobtrusively behind the scenes for comparatively modest compensation. These men are the aircraft accident investigators of the Civil Aeronautics Board.

These junk-pile Sherlocks have been trained to get the answers to the numerous "why's" that inevitably arise when planes succumb to the uninvited wooing of gravity. Their results have been astounding. Their findings, many of which have been translated into regulation or recommendation, have contributed much toward diminishing the hazards of flying.

That invariable phrase "probable cause" which appears in the formal reports of accident investigations is often misleading. It is, for the most part, a concession to legal phraseology. The wording is in accord with the statutory direction of the Civil Aeronautics Act that the Safety Bureau of the CAB determine the "probable cause" of air mishaps.

They are detectives in every sense of the word. To them, a fragment of metal sorted out of a mass of wreckage may be as tell-tale as a fingerprint. A misshapen chunk of engine cylinder may be as revealing as a human autopsy. A twisted strand of control cable may prove as accusatory as a footprint. They have pieced together odd bits of information gathered on the ground and from them read the last thoughts and actions of a pilot who didn't live to tell about them.

So, when the final report lists the "probable cause," it is not to be taken as indecision or an absence of certainty in the minds of those whose job it is to ferret out the facts about plane crackups.

The present emphasis on military aviation has made their task no less important. Many of the safety features incorporated in modern American combat planes—and they are the safest the hazards of war permit—are the outgrowth of their findings in the realm of civil aviation. The work of these men, now and in the future, is certain to be reflected in the fighting craft of our armed services.

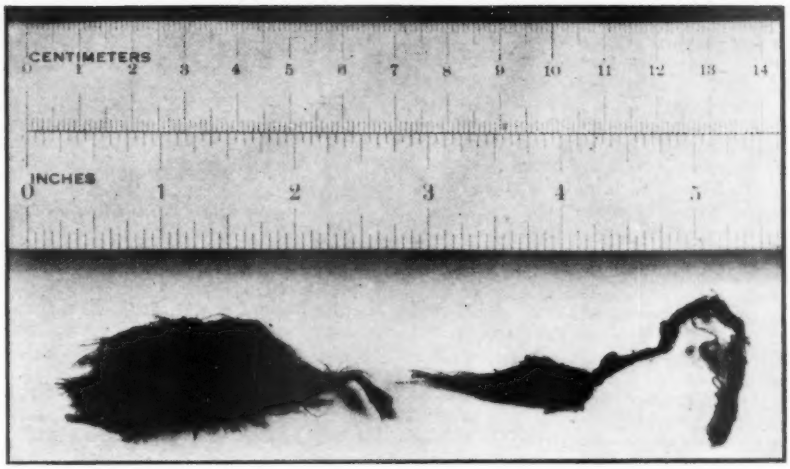
The accident investigating machinery of the CAB's Safety Bureau is small and well-integrated. It is always geared for quick action. Like all good detectives, these investigators move in as fast as it's humanly possible to get to the scene.

International

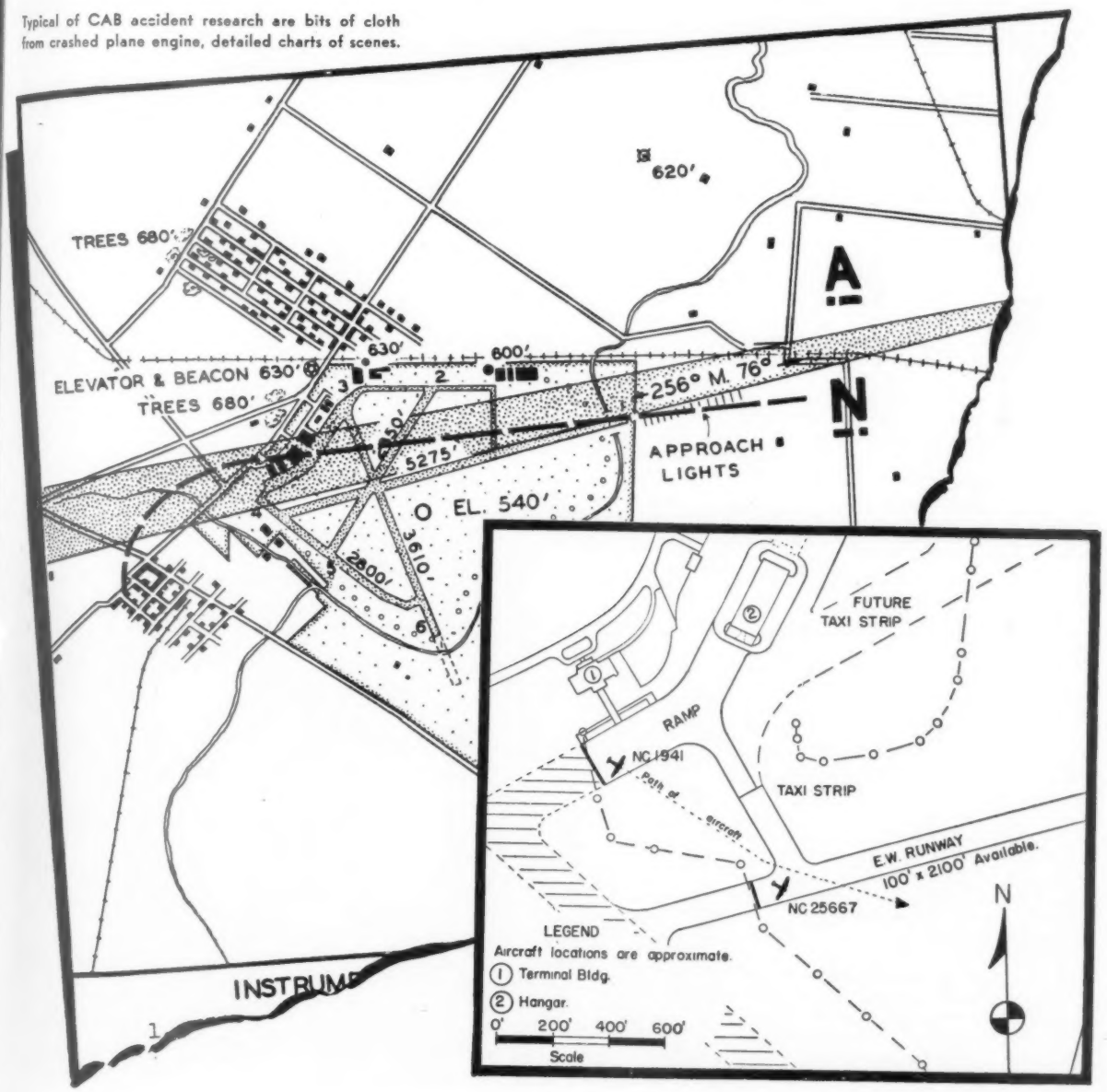
CAB investigators at the scene of a plane crash.

Let's take a look at the whole and then see how its parts work.

Within the Safety Bureau is the Accident Investigation Division. To provide for efficient functioning, the division is split into two sections—the Accident Investigation Section and the Analysis Section. The first section does what its name implies—delves into the causes of individual airplane failures. No less important are the duties of the Analysis Section which grinds out the answers to the problems developed by the field men of the investigating branch. However, instead of dealing with single mishaps, it is engaged with groups of accidents. In this way, it is possible to draw an important lesson out of many accidents that it might be difficult or impossible to deduce from one.



Typical of CAB accident research are bits of cloth from crashed plane engine, detailed charts of scenes.



Decentralized to provide speedy action in any section of the country, the Accident Investigating Section has seven established branch offices. They are located in New York, Atlanta, Chicago, Fort Worth, Kansas City, Los Angeles and Seattle. In addition, there are sub-offices in other smaller flying centers.

"We have tried to put our men where the business is," explained an official.

In addition to its field staff, the section has a corps of specialists stationed in Washington. While the field investigators have a broad knowledge of civil aviation, they often call into consultation experts in particular fields of aeronautics if the investigation points to special circumstances or conditions.

These experts variously specialize in aircraft structure, engines and propellers, meteorology and airline operation and maintenance. It is their job to back up the work of the field men with their specialized knowledge.

For example, if the field investigation develops some evidence of failure in an aircraft part, the specialist in aircraft structure is called in. On occasion, even the experts find it necessary to seek answers to any puzzling or mysterious development by going into the laboratory. Then the facilities of the Bureau of Standards in Washington or the Forest Products Laboratory in Madison, Wis., are utilized.

What happens when an airliner has had an accident? For the sake of illustration, let us suppose that the plane has crashed in some remote area of Georgia. Farmers living nearby have witnessed the crash. One of them telephones the county sheriff. He, in turn, telephones the state police, who immediately notify the airline's representative at the nearest airport. Then the Safety Bureau's office at Atlanta is advised and headquarters in Washington also is informed.

The Atlanta Safety Bureau official orders field investigators to the scene. There is no waiting for orders from Washington. Meanwhile, the state police have gone to the wreck site at the request of the federal authorities to preserve the wreckage and guard it from the inevitable souvenir-hunters.

At the scene, the investigators learn from some of the local folk that a heavy rain squall was in progress at the time of the crash. Others tell of hearing the sound of faltering motors. A preliminary report is made by telephone to Washington. Engine and meteorological specialists stationed in the capital are ordered to fly to the crash scene.

The investigators study every piece of wreckage, sorting out parts that appear suspect for one reason or another. Instruments are preserved for whatever data they might furnish. Distances are measured from the point of impact to places where wreckage has been found.

Witnesses' stories are taken. Some may have seen the plane in the air miles from the scene of the crash and may be able to shed some light on the craft's behavior prior to the accident. Others witnessed the actual smash-up.

(Continued on page 72)

Helicopters for War?

by ROWLAND CARTER

Not overlooking anything, the U. S. Army Air Forces now are conducting tests on an American "windmill."

OPERATING from the world's smallest airdrome, a landing space 20 feet square "somewhere in the U. S. A.," the Army is quietly trying to perfect the helicopter and adapt it to use as a valuable military weapon.

With the co-operation of the veteran Igor Sikorsky, builder of a spectacular pioneer machine, intensive efforts are in progress to telescope years of normal peacetime development into a relatively brief period. In the light of the powerful impetus given airplane advances in the first World War, that is a turn of first rate importance to aeronautics.

If the present efforts succeed, there is a promise that this country will acquire an unique weapon and move strides ahead in the perfection of rotor-driven aircraft for peacetime uses. Prior to Munich, the Germans were ahead in this branch of aeronautical development, but unless they have been more successful recently than heretofore in hiding what they are up to, they have been forced by the exigencies of a losing war to focus their talents on conventional military aircraft.

As befits its experimental status, details of the Army's project are hedged about with secrecy, but this much can be said: A number of helicopters have been ordered and they will be service tested when delivered. The next step depends on what these tests show.

The kindred autogiro is not out of the picture by any means. Improved models able to get into the air from a small space by means of a jump takeoff are being acquired. But there is an official feeling that the autogiro with its conventional propeller for forward propulsion is a transition stage to the helicopter, whose whirling rotor is directly power driven.

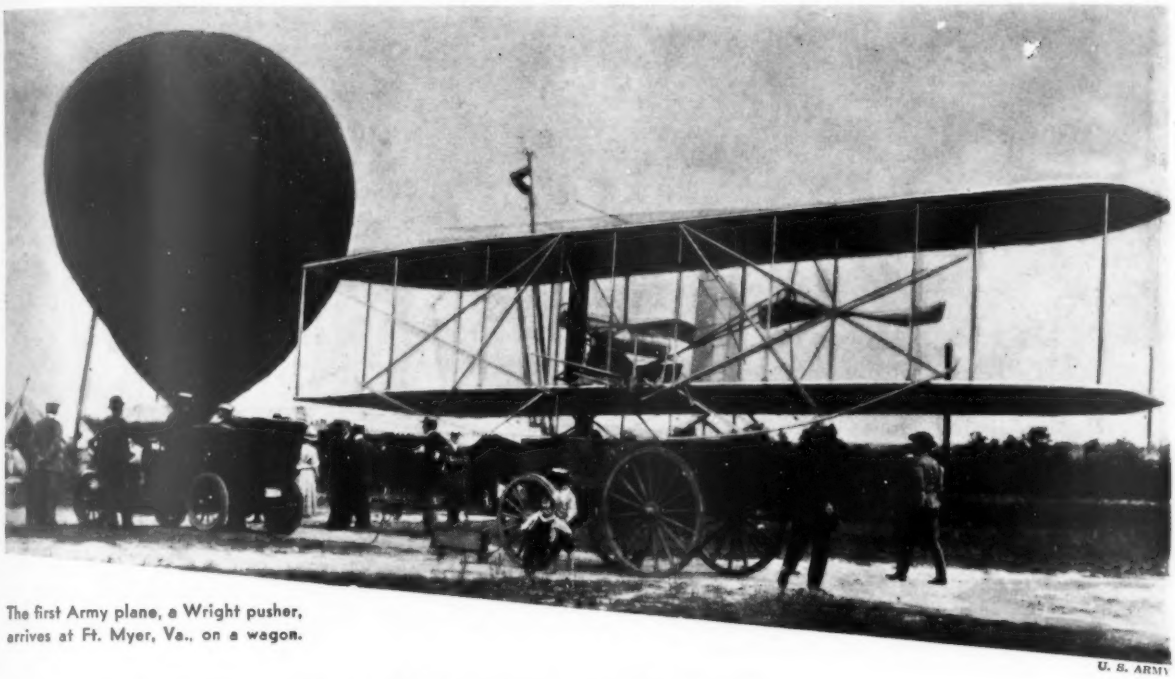
Just what particular purposes are in view for the wingless gyroplanes the Army is not saying, but their military possibilities are obviously varied. Requiring no runway for takeoff or landing, a helicopter, for instance, could operate from a ship's deck, hover over a convoy to spot marauding U-boats and, from a virtually stationary position aloft, drop a depth charge with exceptional accuracy should an enemy submarine come within range.

The same ability to hover promises a definite advantage for the helicopter over the lightplanes now used as spotters for field artillery. A helicopter, it already has been demonstrated, can take a field telephone aloft and maintain a continuous contact with the ground via an unreeled wire, thereby setting up a means of communication not subject to enemy jamming of the air and to the troubles which at times afflict the radio.

As a liaison or courier plane, the heli-

(Continued on page 138)

Igor Sikorsky is at the controls of his helicopter. On this flight he hovered for one hour and 32½ minutes, breaking the old German record of one hour and 20 minutes.



The first Army plane, a Wright pusher, arrives at Ft. Myer, Va., on a wagon.

U. S. ARMY

THE WRIGHTS WERE RIGHT

by WILLIAM LEVENOR

Smithsonian Institution ends argument with their admission that the Wrights were the first to fly.

WELL, it's settled at last.

The Smithsonian Institution has admitted—apologetically, categorically, formally and officially—that the Wright brothers, Wilbur and Orville, not only were the first to build a heavier-than-air machine which actually carried a man in free flight on its own power, but were the first to build such a machine "capable" of free flight with a human cargo.

Thus ends the most celebrated controversy in all the history of aviation. For years the Smithsonian, an institution founded to foster scientific truth and progress, had clung with childish stubbornness to a partisan attitude that one of its former officials, the late Dr. Samuel Pierpont Langley, was the creator of the first airplane "capable" of free flight.

Once that biased opinion had been adopted officially by the Smithsonian, the record could be set straight only when direction of the institution came into the hands of a man of sufficient moral courage to overrule precedent, deny the claims and admit the mistakes of his predecessors, and apologize handsomely for their unfairness—Dr. Charles G. Abbot, the present secretary of the Smithsonian.

His apology was made in an official publication of the institution, called "The 1914 Tests of the Langley 'Aerodrome'" and it has been accepted by Orville Wright, the gentle and modest genius who has been the principal sufferer from the Smithsonian's official attitude.

It might be said that the controversy began with the 1914 tests of Langley's machine, but its actual beginning was in 1903, the year of Langley's failure and of the Wrights' success.

Man's dreams of flight are ancient, but they began really to take shape only in the latter part of the 19th century. The experiments of dozens of men, including many now forgotten, contributed to the rapid solution of the problem. Particularly notable were the glider flights of Otto Lilienthal in Germany. He died in 1896, in an accident attributed to insufficient control of the equilibrium of one of his gliders, which he balanced by shifting the weight of his body.

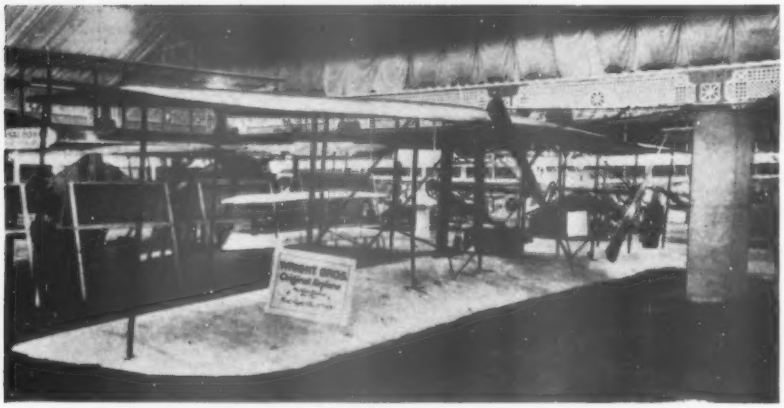
But his efforts had spurred others to more intensive work and study, and among those drawn to the problem of flight by reading of Lilienthal's accomplishments were Wilbur and Orville Wright. Their first interest in gliding was as a sport, but they progressed quickly to a serious interest in the scientific problems of flight in a heavier-than-air machine and soon came to the conclusion that Lilienthal's weight-shifting control was incapable of the needed development.

Gradually they evolved a system with a constant center of gravity, controlling the equilibrium by varying the pressure of air on portions of the wings and auxiliary surfaces. This system, which they patented, now is known generally as aileron control, and is used in every modern airplane.

In 1901, finding existing data on the principles of flight untrustworthy, the Wrights built a wind tunnel at their bicycle shop in Dayton, O. From their experiments with lift and drag they accumulated a mass of information and became convinced that it was possible to predict, solely on the basis of pre-construction calculations, the performance of a flying machine.

This seems today a matter of such everyday engineering routine that it is difficult to remember just how astounding an advance in scientific method the two brothers had achieved; it is quite easy to say "of course" after someone else has pointed the way.

The Wrights, after their pioneer wind



The first Wright airplane is "on loan" to the Times Museum at South Kensington, England. The plane might be returned to the Smithsonian at the end of this war.

tunnel tests, concluded that they could design a plane that would fly with the use of only one-fourth to one-half the power called for in earlier proposed flying machines.

So, in 1902, they began the plans of an airplane to use a four-cylinder, 12-hp. engine. The completed machine weighed 750 pounds, including the pilot. At Kitty Hawk, N. C., on December 17, 1903, this machine made four sustained flights.

"A very modest flight compared with that of birds," the brothers wrote of the occasion, "but it was nevertheless the first flight in the history of the world in which a machine, carrying a man, had raised itself by its own power into the air in free flight, had sailed forward on a level course without reduction of speed, and had finally landed without being wrecked."

One of the wildest and oldest dreams of man had become a reality.

The Wrights, of course, were not the only ones who had been working on the problem. Perhaps the most notable in America at that time was Dr. Langley, secretary of the Smithsonian. He also thought he had the problem licked, and he had made a model which achieved flight in 1896. In 1903, the Government commissioned him to make the attempt with a full-sized machine, capable of carrying a man.

Differing radically from the Wright machine, Langley's was designed to be launched by catapult. Two attempts were made in 1903 to get it into the air, but neither succeeded, and the aerodrome was so badly wrecked in the second effort that the attempt was abandoned. In both instances, the launching mechanism had failed, a fact which contributed to the later attempt to prove that Langley's machine, or "aerodrome," actually was capable of flight.

The success of the Wright brothers later the same year should have settled the first-flight contest in all its particulars, but it didn't. Passing over all the rapid aeronautical devolpments which followed it, and only mentioning the unfortunate death of Wilbur Wright in 1912, the subsequent controversy can be reviewed in the words of Dr. Abbot's pamphlet, dated October 24, 1942:

"It is everywhere acknowledged that the Wright brothers were the first to make sustained flights in a heavier-than-air machine at Kitty Hawk, N. C., on December 17, 1903.

"Mainly because of acts and statements of former officers of the Smithsonian Institution, arising from tests made with the reconditioned Langley plane of 1903, at Hammondsport, N. Y., in 1914, Dr. Orville Wright feels that the Institution adopted an unfair and injurious attitude. He therefore sent the original Wright Kitty Hawk plane to England in 1928. The nature of the acts and statements referred to are as follows:

"In March, 1914, Secretary Walcott contracted with Glenn H. Curtiss to attempt a flight with the Langley machine. This action seems ill-considered and open to criticism. For in January, 1914, the United States Court of Appeals, second circuit, had handed down a decision recognizing the Wrights as 'pioneers in the practical art of flying with heavier-than-air machines' and pronouncing Glenn H. Curtiss an infringer of their patent. Hence, in view of probable further litigation, the Wrights stood to lose in fame and revenue and Curtiss stood to gain pecuniarily, should the experiments at Hammondsport indicate that Langley's plane was capable of sustained flight in 1903, previous to the successful flights made December 17, 1903, by the Wrights at Kitty Hawk, N. C.

"The machine was shipped to Curtiss at Hammondsport, N. Y., in April. Dr. Zahn, the recorder of the Langley Aerodynamical Laboratory and expert witness for Curtiss in the patent litigation, was at Hammondsport at official representative of the Smithsonian Institution during the time the machine was being reconstructed and tested. In the reconstruction the machine was changed from what it was in 1903, in a number of particulars as given in Dr. Wright's list of differences which appears later in this paper. On the 28th of May and the 2d of June, 1914, attempts to fly were made. After acquiring speed by running on hydroplane floats on the surface of Lake Keuka the machine lifted into the air several different times. The longest time off the water with the Langley motor was approximately five seconds. Dr. Zahn stated that 'it was apparent that owing to the great weight which had been given to the structure by adding the floats it was necessary to increase the propeller thrust.' So no further attempts were made to fly with the Langley 52 hp. engine.

"It is to be regretted that the Institution published statements repeatedly to the effect that these experiments of 1914 demonstrated that Langley's plane of 1903, without essential modification, was the first heavier-than-air machine capable of maintaining sustained human flight.

"As first exhibited in the United States National Museum, January 15, 1918, the restored Langley plane of 1903 bore the following label:

'THE ORIGINAL, FULL-SIZE 'LANGLEY FLYING MACHINE, 1903.' For this simple label others were later substituted containing the claim that Langley's machine 'was the first man-carrying aeroplane in the history of the world capable of sustained free flight.'

"Though the matter of the label is not now an issue, it seems only fair to the Institution to say that in September, 1928, Secretary Abbot finally caused the label of the Langley machine to be changed to read simply as follows:

LANGLEY AERODROME
THE ORIGINAL SAMUEL PIERPONT LANGLEY FLYING MACHINE OF 1903, RESTORED.
Deposited by
The Smithsonian Institution
301,613

This change has frequently been overlooked by writers on the controversy. . . .

"Since I became Secretary, in 1928, I have made many efforts to compose the Smithsonian-Wright controversy, which I inherited. I will now, speaking for the Smithsonian Institution, make the following statement in an attempt to correct as far as now possible acts and assertions of former Smithsonian officials that may have been misleading or are held to be detrimental to the Wrights.

"1. I sincerely regret that the Institution employed to make the tests of 1914, an agent who had been an unsuccessful defendant in patent litigation brought against him by the Wrights.

"2. I sincerely regret that statements were repeatedly made by officers of the Institution that the Langley machine was flown in 1914 'with certain changes of the machine necessary to use pontoons,' without mentioning the other changes included in Dr. Wright's list.

"3. I point out that Assistant Secretary Rathbun was misinformed when he stated that the Langley machine 'without modification' made 'successful flights.'

"4. I sincerely regret the public statement by officers of the Institution that 'The tests' (of 1914) showed 'that the late Secretary Langley had succeeded in building the first aeroplane capable of sustained free flight with a man.'

"5. Leaving to experts to formulate the conclusions arising from the 1914 tests as a whole, in view of all the facts, I repeat in substance, but with amendments, what I have already published in

(*Continued on page* 130)

The "Lancaster I" has four 1,280 h.p. engines and hydraulic turrets with 10 .30 caliber guns.

LANCASTER PRODUCTION

Photographs from Black Star and British Combine

BRITAIN'S Avro *Lancaster* is the newest of the RAF's "Big Three" heavy bombers. The other two, in the order they went into action, are the Short *Stirling* and the Handley-Page *Halifax*. All three conform generally to the same classification, although a bit the greater emphasis is being placed on the *Lancaster*. Originally, the *Lancaster* was the twin-engined Avro *Manchester*. Trouble with the engine intended for the *Manchester* caused the change to four 1,280 h.p. Rolls-Royce *Merlin XX's;* the *Lancaster II* is equipped with four 1,600 h.p. Bristol *Hercules* radials, and is manufactured in Canada.

The *Lancaster* is a weight-carrying behemoth. Its normal bomb load is 7.9 tons, but the airplane's maximum overload permits an additional ton to be added for short missions. Empty, the *Lancaster* weighs a little over 17 tons. In its maximum overload condition, it weighs over 31 tons. Wing span is 102 ft., giving the ship a wing loading of 49.7 lbs. per sq. ft. Length is 69 ft. 4 in., height is 20 ft. Most serious fault in the *Lancaster* is its lack of defensive armament. Its 10 .30 caliber machine guns compare unfavorably with the 13-plus .50 caliber guns in the Boeing *Fortress*.

These are the transparent plastic canopies that cover the cockpit. They are hoisted by crane to the fuselage line.

Thousands of British women are manufacturing "Lancasters." This 6,500-ton press is stamping wing and fuselage parts.

Wiring and cables in "Lancaster" nose operate all instruments as well as flight controls that fly the airplane.

CARRIERS

by Lieut.
FRED TUPPER, Jr.

Photographs from U. S. Navy

First of the Navy's training carriers is the "Wolverine." Pilots get carrier training in combat types and SNJ-3's on the deck at left.

COMING UP!

Capt. Roscoe L. Bowman

That the carrier is replacing the battleship in the U.S. Navy is indicated by the huge training program now underway with carriers like the U.S.S. Wolverine.

"GIVE us airplane carriers—more carriers than the enemy," said Rear Adm. F. C. Sherman, skipper of the gallant *Lexington*, "and we'll do the job.' Congress has acted in its own right. Battleship plans have been scrapped, merchant vessels and cruisers hastily converted and appropriations for 500,000 more tons earmarked for instant use. A dozen new carriers will be on the high seas by late summer.

Air power has come of age and carriers are the opening wedge of its effectiveness —the means to bring air power into play when and where it counts. It was planes from carriers that opened the American Naval offensive along the Pacific front at Lae and Salamaua, at Wake and Marshall—planes from carriers that helped win the battles of Coral Sea and Midway —planes flown ashore from carrier decks to fight the battle of the Solomons.

Carriers, yes! And crews to man them. That has been an immediate problem to Naval aviation. No longer are carriers available for training purposes, they are in combat areas. In the early days of war, new pilots were relegated to practice fields, painted off to simulate carrier decks, for take-off and landing drills. That was ersatz; Uncle Sam has found a better substitute.

It's the *U.S.S. Wolverine*, the largest coal-burning, side-wheeling excursion steamer ever to ply the Great Lakes. She was taken over by the Navy last March and converted into an aircraft training carrier, first of her type in the world.

The huge ballroom that used to reverberate under the feet of happy weekenders has become a 550-foot flight deck; the corridors for moonstruck prowlers are catwalks for the ground crews. The salon is the pilots' wardroom. Emptied of scotch and bourbon, the buffet still is open—a perpetual fount of hot coffee and sandwiches for chilled flyers.

The *Wolverine* moors in Lake Michigan, a grim, reminder of modern warfare incongruously silhouetted against the Chicago skyline. Physically she is close by, easily visible a mile or two away at anchor. But, as she pulls away each morning for her day's maneuvers, her doings and the life aboard her become as mystifying to the shorewatchers as those of a sea-borne carrier in the far-off Pacific.

Her "recorder," a freckled-faced, young aviation mechanic, could tell you something about her. His books show that more than 3,000 take-offs and landings had been made in her first four months of duty, that she had qualified more than 400 of her flying ensigns for duty somewhere in the far Pacific.

"Another trainer like this one," says her skipper, Capt. R. L. "Happy" Bowman, "and the Navy could qualify her entire pilot program for carrier duty." It is understood that the *Greater Buffalo*, another Great Lakes steamer, will be converted for similar duty by March.

Actually, flight conditions aboard the *Wolverine* are approximately the same as on an ocean-going carrier. Differences are minor. The flight deck is shorter than that of a big carrier like the *Ranger* or *Saratoga* but longer than some of the converted merchantmen now seeing active service. The *Wolverine* develops less speed than a big carrier but she is fast enough for practical training purposes. There are no hangar decks or elevators aboard her, since planes are flown in from the Glenview Air Station in the morning and back again at night.

Pilot personnel changes rapidly. By and large, the men have had up to 300 hours under their safety belts when they come aboard, including three months training in combat type aircraft after winning their wings at the Navy's huge air training stations at Pensacola, Fla., and Corpus Christi, Tex. To qualify for duty in carrier-based planes, such as the *Avenger* torpedo bomber, the *Seagull* scout observation plane (SO3C), the *Dauntless* dive bomber, and the *Wildcat* and *Corsair* fighters, pilots must have a minimum of eight successful take-offs and landings aboard the *Wolverine*. Most

Former "Lexington" flyers, these officers now on "Wolverine" are (left to right) Lieuts. John Clark, J. T. Bollinger, air officer; and Charles Roemer, landing officer.

of them get many more than that.

As the planes bank into the landing circle before coming into the groove, the landing signal officer, Lieut. Charles Roemer, waves his paddles from the ramp. Lieutenant Roemer, assistant signal officer on the old *Lexington*, is a veteran of thousands of such landings. At his command are a dozen signals, including the wave-off, all designed to correct the pilot's approach and bring him in safely. "We use as few signals as possible," Roemer says, "We don't want to fly 'em in—we want the pilots to do that themselves."

Roemer and his assistant, Lieut. (j.g.) John M. Clarke (who wears the Navy Cross for bombing a Jap carrier in the Coral Sea), have other duties. They are training landing signal officers for newly commissioned carriers. The majority of these trainees are experienced Naval aviators although, with the rapid expansion of the Navy, experiments are being made with aviation volunteer specialists. They receive their field training at advanced operational bases, then are brought aboard.

Standing behind Roemer on the ramp, they watch him "bring in" plane after plane, at the same time running over in their minds the signals they think should be made. If different than Roemer's, they ask and receive explanations. After several hundred assisted landing operation signals and as many unassisted, these trainees are qualified for Fleet assignment. The *Wolverine* is ideal for such training. There is plenty of time, no pressure and night operations, almost impossible at sea, are conducted regularly—with lighted wands instead of paddles.

A fighting squadron operating from a carrier in the Pacific generally has a ground crew of 75 men. So, too, has the *Wolverine*. The majority of the men are stationed aboard ship but every two weeks some two dozen graduates of the A.M.M. school at the Navy Pier, Chicago, are assigned to training duty aboard before going out to carriers in the Fleet.

In colored helmets and skivvy shirts the ground crew races through its duties. Time is precious in carrier operation, so precious that seconds may jeopardize the whole success of an operation and mean the death throes of the carrier itself. A ground crew is trained to do its stuff—rapidly and well.

The complement lists 15 fire fighters, including the oft-pictured character in the asbestos suit, whose mission is just that—to prevent and put out fires; eight men, generally seamen, who raise and lower the barriers on the flight deck for take-offs; eight plane directors and spotters, rated men, who direct the flow of traffic to the take-off line and on a regular carrier, spot the planes for transfer by elevator from hangar deck to flight deck and return; four talkers, one each with the landing signal officer, flight deck officer and the captain on the bridge, to transmit orders; four handling crews of eight men apiece, who gas, maintain and overhaul the planes and five men at the various arresting gear stations. There is also the recorder, whose duties have been described, and a hook-spotter, who stands

(*Continued on page* 139)

By special arrangement this monthly feature appears simultaneously in FLYING and "The Aeroplane" London

EVENTS of the past 30 days indicate that those of us who have placed our faith in the growing might of America's aerial arm will soon see our dreams translated into military reality. The signs which point the road American fighting power is to take are unmistakable. Within the short space of a year American military leadership has revolutionized its views on aerial striking power, and has gone most of the distance toward accepting the battle-plane as the primary instrument of combat. There is little left of the classic hostility which old line military men had once shown toward the independent strategical mission of the airplane.

William B. Ziff.

I venture to predict that basic American strategy, in concord with a similar development in British thinking, will be directed in 1943 toward the smashing of the already wobbly German transportation system in an effort to precipitate an internal collapse of the Reich.

There will also be a fundamental revision of tactics in the Pacific Theater. Every effort will be made to utilize the Asiatic mainland as a base for aerial assault against the Japanese islands themselves. Combined with this operation there will be a vast acceleration of the submarine campaign, designed to tear Japan's sea communications to shreds.

We will undoubtedly retain the strategic initiative, utilizing the fully unleashed force of air power as our primary striking arm. The scope of the recently laid out program and the inevitable strategy which must follow in its wake, is fantastic.

Some inkling into this imposing power structure was given in President Roosevelt's fireside chat of January 8th, in which he promised the Axis that "no matter where and when we strike by land, we and the British and the Russians will hit them from the air heavily and relentlessly, day in and day out."

The coming direction of American military development may also be seen in a joint statement issued a few days earlier by WPB and the War and Navy Departments, stressing that "great importance in the strategic plans for this year is placed on aircraft, merchant shipping, and naval and combat vessels." It is significant that the manufacture of tanks, ammunition, guns and military vehicles will be first reduced by 15 per cent (perhaps by more later) in order to release materials and facilities for the aircraft production line (which will receive the lion's share of the benefit from this move). The tank program itself has been reduced 20 per cent. At the same time it is planned to build "about twice the number and four times the weight of planes built in 1942, with emphasis continued on bombers designed to carry the maximum destruction to the enemy fighting forces and industrial centers."

Only a few months ago the suggestion that plants engaged in the manufacture of tanks or ordnance be converted to the production of aircraft was regarded as the outpourings of air power maniacs. Today it is no longer even radical.

It is plain that air power is stepping out of the "auxiliary" phase, and that America's streamlined forces are to be placed on wings in a determined effort to seize absolute control of the aerial ocean which will be the dominant battle sphere of the future. The view is given in the frank statement by Lieut. Gen. H. H. Arnold that mounting power of the Allies "will win the war in the air" during 1943, pressing inexorably toward complete victory.

The monthly American output of airplanes is now well over 5,000 of all types. In 1943 a production of 10,000 a month is planned, with special emphasis on huge bomb carriers which will make the present *Fortress* (B-17) and *Liberator* (B-24) types look small. According to Lieutenant General Arnold, the firepower in these newest ships will make the present .50 caliber machine guns "seem like peashooters."

The U. S. Army Air Forces now contain something over one million men. In 1943 it is planned to increase these to somewhere around 2,500,000.

It is believed here that the total German production of all types cannot exceed 2,500 a month. Japanese production is certainly under 1,000, while that of our ally, Britain, must be near the 3,000 mark. With their installations and productive facilities under continual assault, the Axis air forces will have passed their peak and be on the down grade. At least this is the assumption of that section of our military planners who have been converted to the scheme of all-out air attack.

Great satisfaction is expressed here over the account the Boeing *Fortress* and the Consolidated *Liberator* types have given of themselves. These have succeeded in various engagements in fighting their way through determined enemy opposition in broad daylight with relatively

(*Continued on page* 134)

AIR TRAFFIC TO COME

American Airlines

Airport and airways traffic systems now in use are the pattern for traffic handling to be used after the war.

Now head of the Air Traffic Control Division of the CAA, Mr. Gilbert first entered the field of air traffic control in 1935 as an American Airlines employee. He set up the first airway traffic control center at Chicago, joining the CAA in 1936. He went to Washington 18 months later. In addition to heading the Air Traffic Control Division, Mr. Gilbert is chairman of the technical committee on airway traffic control of the Radio Technical Committee on Aeronautics, a group having a membership representing the military services, airlines, airline pilots and the Civil Aeronautics Administration.

by GLEN A. GILBERT

Everyone has talked about the vast expansion in flying to come after the war. To regulate the traffic jam will be a major CAA problem.

WHEN the air traffic controllers of the Civil Aeronautics Administration look at their job for the future, they see the following:

"Within a few years after peace returns to the world the airlines of the United States will be carrying 20,000,000 passengers a year and half a million Americans will be flying their own planes. Regular freight planes will be flying the airways and all first class mail will go by air. There will be feeder airlines to smaller cities and pick-up service to the villages."

What to do with all these airplanes, how to keep them from running into each other in the air and how to land them safely is involved in long range plans, now being built upon experience in controlling far less traffic. During 1938, the airway traffic control centers of the CAA handled approximately 300,000 aircraft movements. This jumped to 1,500,000 in 1941, and in 1942 to 6,000,000. In 1943, it will probably be 15,000,000, CAA aerial traffic experts believe, and it may well reach 60,000,000 by 1950.

In making overall plans, they restrict themselves largely to airlines and some private flying, plus the military. While the military traffic looms large now—accounting for 80 per cent of the airways traffic—this is expected to decrease rapidly when peace comes. Airline traffic (consisting of freight, passenger and mail planes) and private traffic are certain to increase, and herein lies most of the problems.

The plans which the Traffic Control Division have made for handling this expected greater volume of air traffic may not resemble at all the actual methods which will be used. In the first place, all such plans involve appropriations, and these are never too certain in government. In the second place, developments of a secret nature (spurred on by the war) even now promise to supersede some of the advanced ideas on which the technical development experts of the CAA are at work, so that at the war's end many new and valuable aids to flying may be ready for quick adoption by private and commercial flyers.

Generally, as the traffic men now see the problem, today's control system will be used with expansions and improvement. There may be a few more than the present 23 air traffic control centers, but areas controlled by these centers, averaging 1,600 miles of airways each, will probably be broken down into smaller sectors. Today's radio range system will probably be continued, except that all ranges will be shifted over

(*Continued on page* 130)

'Observe and Report'

U.S. Army

The high-wing Curtiss O-52 equipped with radio, fixed and hand cameras is the ground troop's eyes.

by Lieut. THURMAN E. BERCAW

Brooks Field trains observers who seek, with fact-finding eyes, information to outfight the enemy's ground, sea and air forces.

THE orders are simple and direct. "Observe and report." That's all there is to it for the Army Air Forces' observer when he takes to combat duty after his nine weeks of training at the Army's aerial observer school at Brooks Field, Tex.

"Observe and report." The orders are simple; but the task is frequently difficult and complex. It's a job for keen, alert men, teams of men, who fly far over the enemy's lines. Their job in the blitzkreig war is to gather the battlefield information which shall enable American forces to outmaneuver, outfire and outwit the armies, navies and air forces of the axis powers.

Into the classrooms at Brooks Field go men from all branches of the Army—from the infantry, from the artillery and the cavalry. And for the purposes of training and for combat operations, these men become part of the Air Forces. They become the eyes—the unerring, photographic eyes—of the guns, the tanks and the bombing squadrons that are now gathering for the great push in Europe and in Asia.

Undisclosed numbers of men—observation pilots and their team mates, the men who come in from the ground forces—are being turned out at Brooks under a speeded up course of study. Each class goes through its training in nine weeks—nine weeks crowded with flying navigation, communication, mapping and aerial photography.

The average observer has had several years of experience with other types of fighting units. Therein lies his chief value. He comes to Brooks as an officer well acquainted with the problems of ground force maneuvering. The actual job of completing an observation mission frequently calls for a sharp, suspicious pair of eyes. That a large body of troops might look like anything but just that from the air seems unlikely to the average civilian; yet, a regiment cleverly concealed by camouflage may escape detection by an entire flight of planes roaring overhead at 10,000 feet.

The immediate objective of the pilot-observer team is to establish contact with the enemy long before the opposing armies are within clashing distance. And once this contact is established, the observation craft must keep the enemy under constant surveillance and report his progress at regular, frequent intervals.

Finally the "front" is established. The fight is joined. From that time on out the pilot and his observer are assigned to the job of spotting the distribution and locality of all enemy units. In this task the observer relies upon his camera. Haze, high altitude and the speed of the plane might balk the team's effort to spot enemy positions. But the camera can't be fooled. Haze is cut by the filter. Altitude is overcome by long-range lenses. And the speed of the ship is more than outmatched by the speed of the camera shutter.

Usually the pilot and his observer fly out over enemy territory alone. High-performance ships are taking the place of the slower, fat-bellied planes once assigned to observation squadrons. These new craft make results more certain; they can fly fast—can avoid action and bring home the bacon in the form of vital reports. The "fight through" of the wooden Jennies which was accepted as necessary

in the last war has been minimized by Uncle Sam's modern production line—but observation work is still no job for sissies.

One of the observation ship's jobs is to guide the shells of the artillery by flying in a line with the target, and then signalling by one device or another—usually by radio. The observation ship is also frequently used as a guide to the slower moving tank forces, "leading" them toward their objective. Sometimes these observation ships are protected by our own fighter craft. Sometimes they have to get their work done under attack, and then get back as well as they are able—possibly with a hostile pilot on their very tails, and the observer at the rear flexible machine gun.

The observer who leaves Brooks Field, ultimately to arrive at the theater of operations to begin "shooting" the enemy, is not only an expert photographer. He is an all around tactician with a basic knowledge of ground operations. He understands and uses navigation and communications; he is an accomplished map reader; draws sketches, and, of course, is a gunner.

It's a long hop, however, from the arrival of the potential observer at Brooks Field to the day when he wedges himself into a plane at the fighting zone. He has to be a good man, a *very* good man and a smart one, to make the grade.

First, he must be physically fit, passing the Army Air Forces' high standard, as required of all flying personnel. He must have at least a high school education. Then a practical and intensive system of study and flying faces him. The man who hopes to become one of Uncle's Sam's "eyes" will divide his time between hangar line and classroom.

His first flight is for purposes of orientation. The embryonic observer familiarizes himself with the ship and its equipment. He is then ready for training missions, simulating actual combat. Cross-country navigation flights and night flying are an important part of the training.

One of the most recently developed of military co-ordinations is the air observer-tank co-operation. A plane wings into enemy territory ahead of the tank advance; the observer shoots the terrain and radios information about all he sees that will be of help. Flying back, the films are developed and rough proofs dropped for the guidance of the tank commander, speeding and facilitating the advance. In such co-ordination practices, troops from nearby camps are often used to simulate the real thing. Also, a miniature artillery range and puff-target range give the effect of actual artillery firing conditions which the student must report as though he were at the front. A chart is kept of his observation ability.

U.S. Army

Aerial mapping plans are checked by a pilot-observer team before the take-off.

Radio instruction plays an all-important part in the training of aerial observers.

U.S. Army

"The classroom is as important as the air." This is no mere *cliche* at Brooks, where its commandant, Col. Stanton T. Smith, (credited with over 7,000 flying hours in the air) and his staff of officers are charged with one of this war's great responsibilities. Before being assigned to the front as an observer the student must have a sound general knowledge of basic army ground tactics and be qualified in all 6 of the major phases of aerial observation:

1. The observer must be an expert radio operator. Information he obtains is valueless until reported to the commander. He has to be familiar, therefore, with the set employed, able to make adjustments and change frequencies while in flight.

2. The observer must know how to operate all the standard aerial cameras. He must know how to make swift changes in shutter speed, apertures, focus or filters.

3. Every observer should have sufficient knowledge and training in sketches to enable him to supplement visual or photographic reconnaissance reports, his sketches emphasizing the important features of an area or objective.

4. He should study and know the enemy country. He should have an ability for quick recognition, know sensitive points in lines of communications; oil refineries, water systems, etc. The keen-eyed observer sitting in his cockpit will understand the import of many small, superficially unimportant things. Thin clouds of dust miles away . . . and where are the troops that were in evidence in this locality yesterday?

Field headquarters must know of this change. A word to the pilot. Ten, 20, 30 miles of-scouting—then, off the ground, the dust clouds thicken. And there, finally, moving swiftly, is the "lost" enemy regiment, a dozen pursuit ships covering them. The observation plane, following its orders of evasive action, banks for home. The information is already being relayed to HQ.

5. The observer must be well trained in map reading. It is necessary for him to know the different types of military and special maps and their codes.

6. An ability to use the flexible pursuit gun is often the difference between the successful and unsuccessful completion of a mission. The observer who can hold off a hostile plane long enough to help reach the field safely with the all-important photographs is the right sort of man to have in the cockpit of a reconnaissance ship.

Ground was broken on the site of Brooks Field December 8, 1917, just a quarter century before the Japanese attacked Pearl Harbor. The original base was called Gosport Field, after the system of training at Gosport, England. The name was of short duration, however, for in the following winter the field was permanently renamed in memory of Lieut. Sidney J. Brooks, who was killed while on what was to have been his final flight before winning his commission.

During World War I, Brooks Field turned out hundreds of pilots, most of

(*Continued on page* 141)

U. S. ARMY

With the exception of the Piper "Cub," probably more pilots have learned to fly in a Boeing PT-17 (also known as the Stearman) than any other model of plane.

TOUGH BABY

by WILLIAM D. STROHMEIER

Meet the Boeing "Caydet," which is a fancy name for one of the most rugged airplanes ever built.

ONE pilot will tell you this airplane can stand more than you can. Another will tell you you're not through flying it until its in the hangar. But what you'll hear most of all about it is that it's a "tough baby." It never carried a gun, it never dropped a bomb—but without it we could never win the war.

For "tough baby" is just an unglamorous training plane carrying the officious and dull term: PT-17—PT standing for primary trainer. Better known as the Stearman [now Boeing], it and its predecessors have for years been nearly the standard training plane of both our Army and Navy as well as many other United Nations. Next to *Cubs*, more pilots have probably cut their teeth in Stearmans than any other type of present day training plane built.

In outward appearance, it's just a plain, ordinary biplane. Sitting on its narrow, stilt-like landing gear, it has a certain cockiness to it which, coupled with just enough stagger in the wings, gives it an almost racy mien. Its clean lines, its well-rounded fuselage, and the 225 hp. Continental engine mounted as naked as a new born babe on the front, give the false impression that it's fast. In reality, it's hardly a match for some light airplanes in speed, climb or take-off.

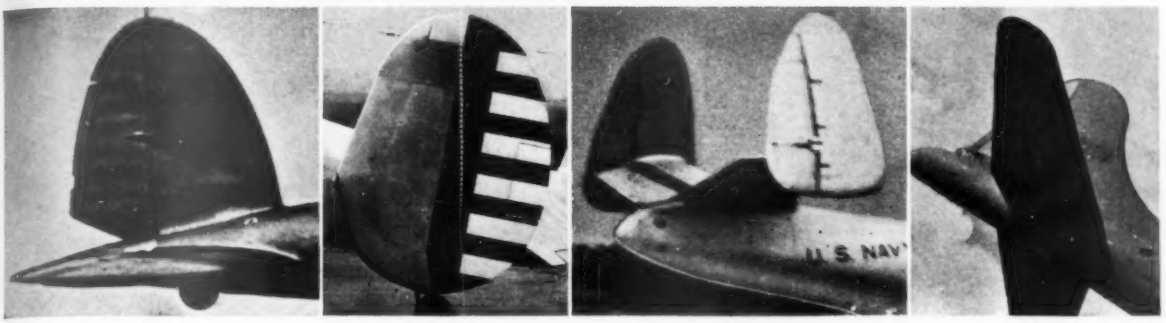
You don't have to fly the airplane to know why they call it tough. All you have to do is look inside to see the strongest looking piece of flying equipment for its size that ever came out of an airplane factory. The longeron members and other cross tubing are the size of boiler pipe. Most impressive of all, however, is a piece of tubing, about the size of a small sewer pipe, down by the floor boards. When you learn that its the main member which connects the two single cantilever strut landing gears you understand how "tough baby" can take all the brutal punishment cadets give it day in and day out.

I was up with a cadet practicing landings one day. On one approach, Dumbjohn in the rear seat started undershooting pretty badly. In innocent style he eased back on the stick trying to stretch his glide into the field (stretching a glide is like stretching a chain). To impress the student with the error of his ways, I let him go a little too far with his glide stretching stunt before I took over. The old PT started selling out at around 50 feet and I thought sure the landing gear would go. We dropped into the most awfulest hard landing I ever hope to see, to my embarrassment and the student's surprise. The jolt was so terrific that for two days my back was sore but not even the rigging of that airplane was out of line! That's what they mean about the airplane taking more than the pilot.

The case of a United Kingdom cadet here in this country learning to fly under

(*Continued on page* 143)

FOR IDENTIFICATION



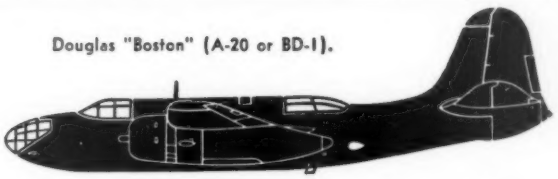
1 2 3 4

This month's planes are: 1. Heinkel He-111K; 2. Beechcraft AT-7 or SNB; 3. Martin "Mariner" (PBM-1); 4. Boeing "Flying Fortress" (B-17E).

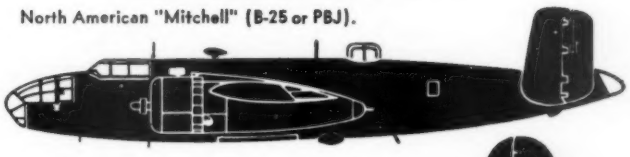
MISTAKEN IDENTITIES

THIS is a new department in our monthly aircraft identification feature. It is a result of research conducted at Northwestern University during the training of Naval aviation cadets in the aircraft identification portion of their ground school course. In classes it was found that numerous aircraft, or just certain views of aircraft, are frequently confused with each other, although the aircraft themselves may be in no way related. One of the mistakes frequently made is in confusing the side views of the Douglas *Boston*, North American *Mitchell* and Martin *Martian*. They are shown at right exactly to scale. Features these three airplanes have in common are their twin air-cooled engines, fully retractable tricycle landing gear, high or high-mid wings. The *Mitchell* is the only one of the three having twin rudders. The single-rudder *Martian* has a tail gun turret; the *Boston* does not. The fuselages of the *Boston* and *Mitchell* are generally rectangular; the *Martian* is cigar-shaped.

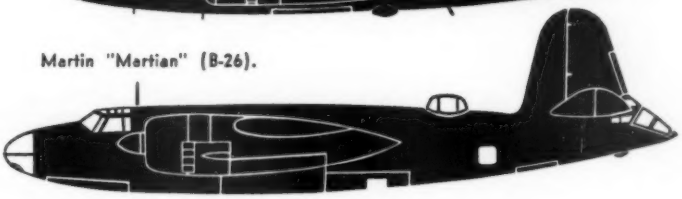
Douglas "Boston" (A-20 or BD-1).



North American "Mitchell" (B-25 or PBJ).



Martin "Martian" (B-26).



MITSUBISHI ZERO (Revised)

As the result of photographs and data supplied by the U. S. Navy, the new silhouette at left is the most accurate drawing of the Mitsubishi 00 now available. Obviously, the Zero captured and put in flying condition by the Navy (above) contributed much technical data.

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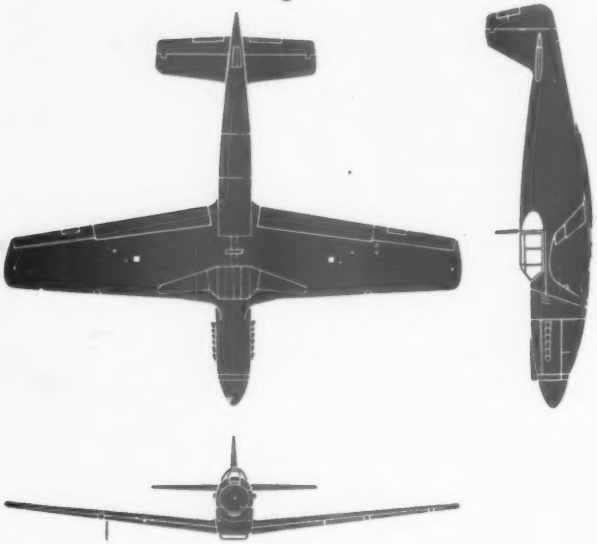
NORTH AMERICAN "MUSTANG" (P-51)

Fighter



PERTINENT FACTS: Having achieved its original fame in the hands of the Army Co-Operation Command of the RAF, the *Mustang* is generally conceded to be one of the finest fighters in its class. A single-place, low-wing monoplane, it is powered wiith an 1,150 h.p. Allison engine. According to British sources, its top speed is 370 m.p.h. (U.S. sources say 390). According to the British, its range is 510 miles at 310 m.p.h. Service ceiling is 31,350 ft. Gross weight is 7,700 lbs. Wing span is 37 ft. 5/16 in., length 32 ft. 2⅞ in., height 8 ft. 8 in. It uses eight .50 caliber guns.

WHAT TO LOOK FOR: According to the RAF, the *Mustang* might be mistaken for the Messerschmitt Me-109E. In reality, they resemble each other mainly in that they have square-cut wing tips. In the *Mustang's* bottom view this can be clearly seen; the wing has moderate taper on leading and trailing edges. The comparatively wide span of the tail is notable. In the side view, note the large air scoop under the fuselage and the square-shaped rudder and fin. The landing gear retracts inward and folds flush. Two of the .50 caliber guns can be seen on the bottom of the cowl.

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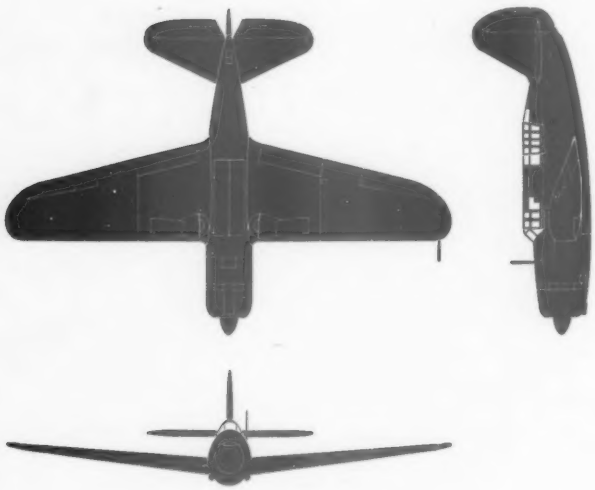
CURTISS "HELLDIVER" (SB2C)

Scout Bomber



PERTINENT FACTS: Little specific information on this airplane has been released by the Navy Department. Actually, all details, including measurements, were classified as restricted as this was written. It can be said only that the model of the *Helldiver* shown here now is in production and numbers of them already are being flown in the Navy, although they had not yet seen combat. A two-place dive bomber, it is heavily armed and carries a large bomb load internally.

WHAT TO LOOK FOR: Many photographs of the original experimental *Helldiver* have been given wide publicity, although the production model has had several important changes made in its external appearance. The *Helldiver* is a conventional low-mid wing monoplane with conventional landing gear designed for carrier operations. In the bottom view note the large wing, with straight leading edge and sharp taper on the trailing edge. There are built-in leading edge slots. In the front view the sharp dihedral and thick wing are seen. The horizontal tail surfaces appear abnormally large in overall size.

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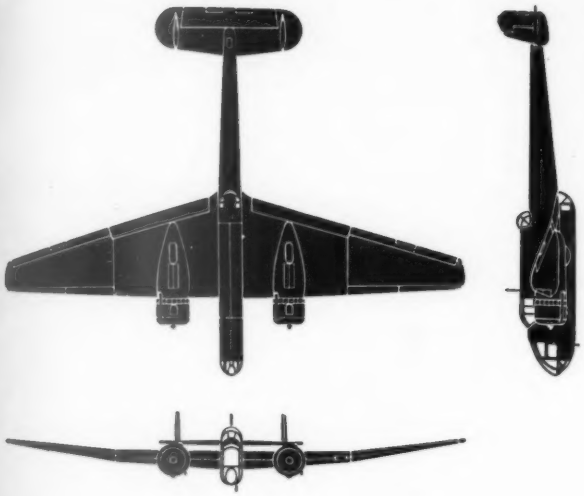
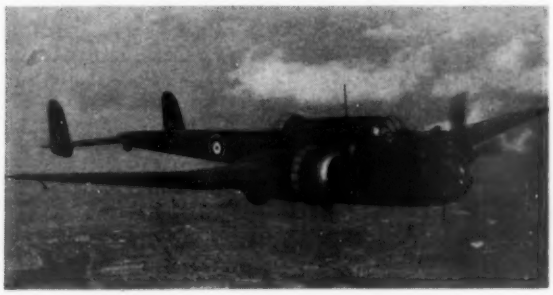
HANDLEY-PAGE "HAMPDEN"

Medium Bomber





PERTINENT FACTS: One of the oldest types still in use by the RAF, the *Hampden* is still reported on an occasional bombing mission, but more often as a mine layer. Powered with two 1,000 h.p. air-cooled engines, it has a top speed of 265 m.p.h. at 15,000 ft. According to the RAF its range is 1,725 miles; service ceiling is 22,500 ft. It is the only remaining bomber in the RAF not using power-driven gun turrets. Wing span is 69 ft. 2 in., length 53 ft. 7 in., height 14 ft. 11 in. Gross weight is 18,756 lbs. It is understood that another version of the *Hampden* has Wright *Cyclones*.

WHAT TO LOOK FOR: A mid-wing monoplane, the *Hampden* can be easily spotted by its narrow single tail boom, carrying twin rudders. The fuselage is particularly deep but narrow, with gun turrets clearly visible on top and bottom. In the bottom view the narrow boom also is notable; the large wing has an almost straight leading edge, but sharply tapered trailing edge. The landing gear is conventional and semi-retractable.

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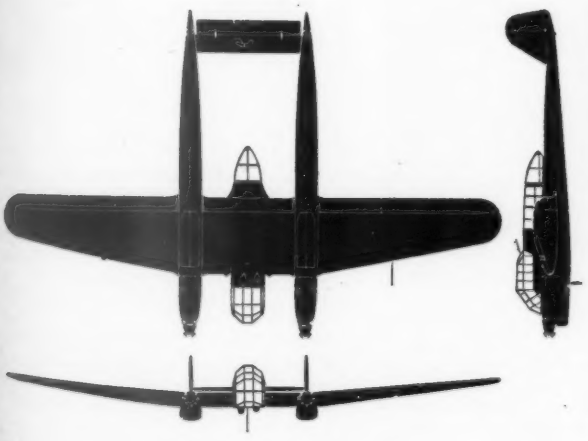
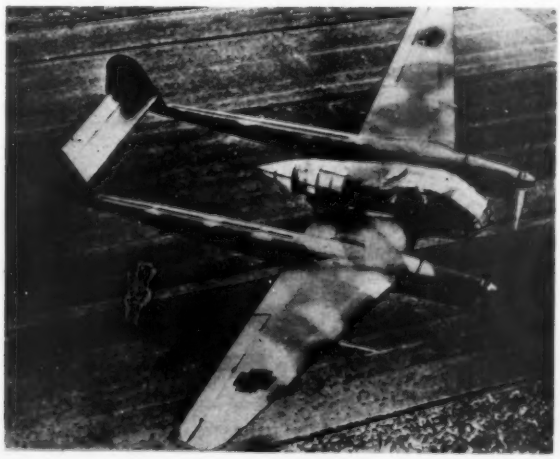
FOCKE-WULF Fw-189

General Purpose





PERTINENT FACTS: Used variously as an attack plane against ground troops, and also as an ambulance and reconnaissance plane, the Fw-189 still is widely used by the Germans, particularly on the Russian front. It is powered with two 450 h.p. Argus air-cooled, inline engines. Maximum speed, according to the British, is 222 m.p.h. Span is 60 ft. 4 in., length 39 ft. 4 in. Gross weight is 7,480 lbs., according to The Aeroplane in London.

WHAT TO LOOK FOR: This should not be mistaken for the Lockheed *Lightning*. It happens to have twin tail booms, but otherwise differs entirely from the American plane. It is a conventional low-wing monoplane with moderate dihedral. Most unusual is the clear, transparent cockpit and turret. Landing gear is conventional and retracts.

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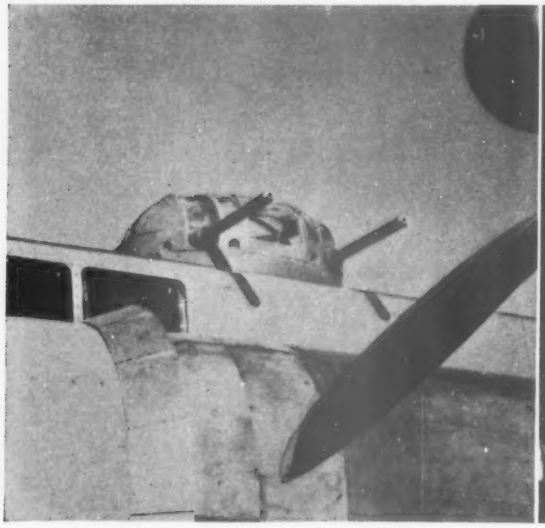
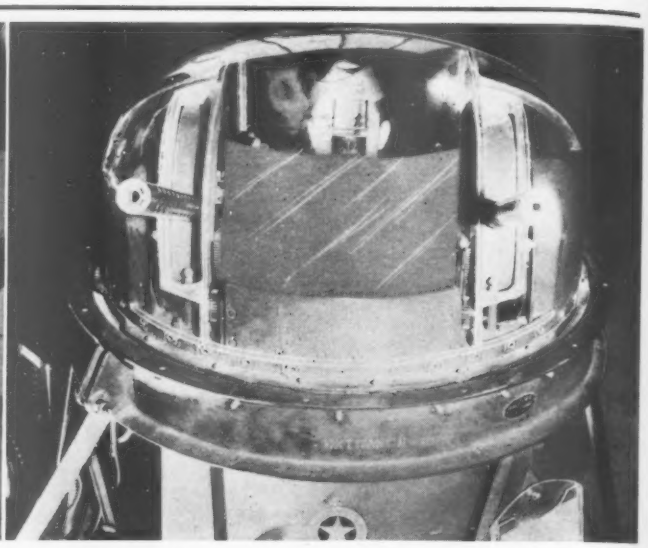
AIR SERVICES *Section*



The swift-turning power-operated top turret of Army's "Flying Fortress" has taken heavy toll of enemy craft.



Twin .50 caliber machine guns are mounted in plexiglass-covered turrets. (Shaded area hides restricted portion of turret.)

THE AAF'S POTENT POWER TURRETS

THERE are many features aboard Uncle Sam's military aircraft that the Axis leaders would give anything to have, and, next to the bombsight, there is one in particular that is causing them plenty of grief these days.

It is a device known as a power turret.

Why it is causing the Axis no end of worry was pointed out recently at Lowry Field, Denver, Colo., where soldiers of Maj. Gen. Walter R. Weaver's Army Air Forces Technical Training Command are being schooled to keep these turrets firing.

The study of turrets is an advanced phase of aerial armament. Lowry Field assigns only the most apt students to classes dealing with this new and potent weapon. The reason for this becomes clear when the general purpose and nature of the power turret are considered.

Technically, a power turret is a gun mount, power operated, which is capable of overcoming the terrific force of the slipstream (air stream driven back by the propellers), thus enabling the gunner to hold a steady aim on his target. This steady aim, or "tracking," is coupled with a sight so effective that it is almost difficult to miss.

There are, of course, a variety of sights, ranging from the simple, non-computing reflector type to the complex, computing sights which solve a variety of problems encountered in air combat, such as range, prediction, ballistics and a number of others.

Turrets of pre-war days and of World War I were hand operated. The need for the power-operated turrets was not felt until the advent of high-speed bombardment and fighter aviation. With this development it became impossible, due to the slipstream force, for a gunner to lean out of the cockpit, and with his ring-mounted machine gun get a steady aim at his target.

Turret permits uncanny accuracy of aim.

Today, power turrets have to contend with fighter planes that travel 380 miles and more per hour. They must, therefore, be operated with a source of power other than manual, preferably electric or hydraulic.

Power turrets made their bow in the early '30s, but it was not until the battle of Dunkirk that they proved their value.

In a surprise appearance over the Dunkirk beaches, according to official announcements from the Royal Air Force, 12 Boulton Paul *Defiants*, one of the first land-based fighter planes to be armed with a power-operated gun turret, shot down 38 Nazi planes without a loss to themselves. What startled the Nazi airmen was that they were shot down when flying parallel with and at presumably safe distances from British aircraft—an operation made possible only with power-operated gun turrets, of which the Germans knew nothing.

With this and similar experiences to guide them, American designers were encouraged to make turrets an integral part of the U. S. bombardment aviation. That this step was not misplaced has been proved consistently by such battles as those at Midway, the Coral Sea, and over the European and North African theaters. Indeed, turrets have changed the approach of American designers to military aircraft construction.

Turrets are located on the top and bottom of medium and heavy bombers. Some bombers also carry a turret in the tail. This armament, supplemented with flexible waist, nose and tail guns, offers such effective intersecting cones of fire that "blind spots" are eliminated. The firepower thus afforded makes hostile air attack unsafe. No matter from what angle enemy fighters approach they are subjected to immediate destruction.

The firepower not only enables a

bomber to complete its mission and return to its base, but permits it to invite combat with fighter planes. A case of the hunted becoming the hunter. *Flying Fortresses,* for instance, can venture forth into Hitler-controlled Europe on bombardment missions without fighter escorts, and when the German fighter aircraft rise up to intercept them, the aerial gunners of the B-17s, well protected by armor plating, are ready to meet them with the most concentrated zones of fire modern military science makes possible.

Anxious though our bomber crews are to combat enemy aircraft, their primary function is to drop their bomb load where it will do the most harm. Consequently, it becomes the primary function of power turrets to see that enemy pursuit ships do not stop the bomber.

Training given to the men at Lowry Field who will maintain these turrets is of the most technical and thorough possible, though the men need not be supermen to grasp it. Usually, Lowry officers explain, they are high school graduates with a mechanical turn of mind.

As maintenance men, their job will be to keep turrets in a state of perfection for the aerial operators.

Toward this end, Lowry Field gives them a highly concentrated eight-week course on all the turrets and sights employed by the U. S. Army Air Forces. They are given a comprehensive understanding of the .50 caliber machine gun, ballistics, hydraulics, electricity, controls and a number of other highly technical and scientific subjects.

In brief, they learn all about a turret and how to repair any malfunction of it instantly, for in combat time is priceless.

At the end of their eight-week course, they are graduated and stand ready to be shipped wherever an AAF power turret maintenance man is needed.

PARACHUTE OFFICER'S "GOLDEN RULE"

"PARACHUTES, like the sea, are not in themselves unsafe, but only terribly unforgiving of any carelessness."

This, in effect, might be the Golden Rule by which Lieut. Wilbur Lage, parachute officer at Ellington Field, Tex., has guided his 20 years as an Army aerial life raft expert through the dangerous early days of flying to today's highly perfected aircraft.

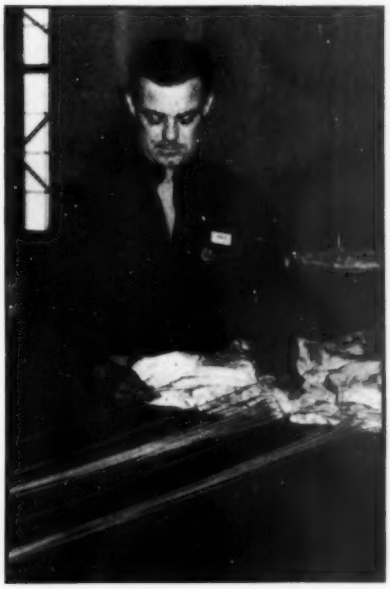
A graduate of the Army's parachute school at Chanute Field, Ill., and the organizer of the Army Air Forces' parachute training schools and departments at Brooks Field, Randolph Field and Ellington, Lieutenant Lage today probably knows as much about parachutes as any man alive.

To him a parachute isn't just a silk umbrella that a man can call upon to save his life in time of emergency in the air; it is almost a living, breathing object. When he talks about his "chutes," there is a tone of respect in his voice. He will spend hours in a busy work day explaining the workings of a parachute to any Army man not acquainted with them.

"Who knows but what that man will some day use that information to save a life," he explains.

"In all my years of working with parachutes," Lieutenant Lage says, "I have never known a case of a parachute failure that could not be attributed to a 'human failure' rather than a failure of the chute itself. Parachute accidents are usually caused by one of three factors—jumping from too low an altitude; opening the chute before clearing the plane, thus having it foul in the tail or wing surfaces; or by not pulling the rip cord."

In discussing the latter cause, Lieutenant Lage admits there is still some mystery in the minds of parachute experts and Army Air Force medical men as to what causes a man to fail to pull a rip cord, once he has jumped.

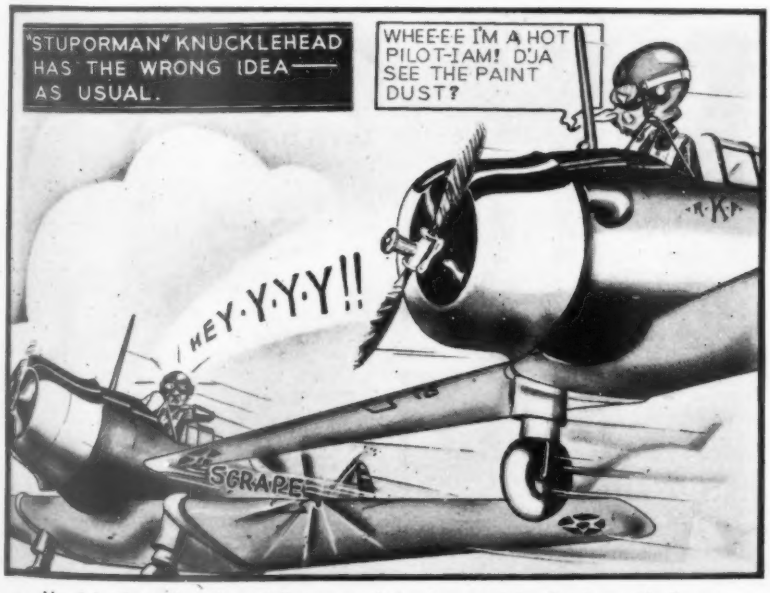


Lieutenant Lage, Army's parachute expert and organizer of 'chute training schools.

"Perhaps he freezes up, just like a man will sometime freeze to the controls of a plane. I don't know. Personally when I have stepped off into space it tends to calm me instead of exciting me. It might affect other men in a different way. The human body is a queer machine sometimes."

Lieutenant Lage made his first parachute jump on March 5, 1923, at Chanute Field and in recognition of that jump he has as one of his treasured mementos an engraved certificate making him a member of "The Rip Cord Club of the World."

THE AAF'S "CADET KNUCKLEHEAD"



No. 3 in the series of specially prepared drawings used by the Army Air Forces to impress upon aviation cadets the "wrong" way of conducting themselves in air.

Navy Training Film

PENSACOLA, the "Annapolis of the Air," is the proving ground for the Navy in many ways. Recently the Bureau of Aeronautics undertook to make its own industrial education training films for use in the training of workers in assembly and repair shops throughout the country—a gigantic task and one that had to be done with great care. The construction of planes was involved and mistakes might mean accidents.

The Bureau commissioned Pensacola's photo laboratory, in conjunction with the vocational training office and the production and inspection divisions of the assembly and repair department, to produce a test slide film. The subject was the installation and test of flight controls and surfaces for the SNJ-2.

The completed film was sent to Washington and approved, and orders issued for the completion of an entire series.

Aerial "Mal de Mer"

THE sea captain who is plagued by *mal de mer* and the structural steel worker who has to grit his teeth against dizzy spells have a brother sufferer—the pilot who possesses a stomach sensitive to aerobatics.

Writing in the United States Naval Medical Bulletin, Lieut. T. T. Flaherty, Medical Corps, United States Navy, proposes a six-point prophylactic program, based upon a 10-month study of flight cadets.

Lieutenant Flaherty discovered that airsickness almost always asserted itself for the first time while the student was learning the art of aerobatics. The affliction is not uncommon among learners, he found, and may be a serious deterrent to progress if not properly treated. He advises the flyer:

1. To adjust the seat to a high position for maximum visibility, being careful, however, that this does not interfere with full throw of the rudder paddles.

2. To fasten the safety belt firmly, thus minimizing "bouncing" and going a long way toward making plane and pilot one, even as the good rider makes himself a part of the horse.

3. To refrain from staring at the instrument board. Rather, he should keep his eyes out of the cockpit as much as possible.

4. Most important, to pick out some point of reference—a sort of guidepost—a long way off. In loops, spins, Immelmann turns, wingovers and other maneuvers, the trainee was told to keep his eyes off the nose and wings of his plane. Instead, he was urged to take a straight stretch of roadway, fence line or even a point on the horizon as an alignment guide. "It was found that most students who became airsick during this maneuver (wingovers) spent a great deal of time looking in the cockpit at the airspeed meter, and the 'needle and ball' indicator, literally flying mechanically by instruments with no points of reference on the earth's surface ever being used. In snap rolls, a point on the horizon or a cloud bank could be taken as a point of reference. This point can be followed during the maneuver and the student will know his position throughout the roll."

5. To avoid executing the same aerobatic over and over "as this tends to cause airsickness to a far greater extent than if they vary them and to wait a short interval between different acrobatics."

6. Never to attempt a landing if extremely airsick, remaining at a reasonable altitude in level flight until the spell is subsided.

Lingo on the Line

HEY, ramp rat, grab that knuckle skinner and don't stumble over the creeper and spill the go fluid or the wing wiper will use a cheater on your scalp.

Sounds goofy, doesn't it? But it's just plain English, garden variety, to the airplane mechanics at the "West Point of the Air." These men have developed a lingo all their own.

Brig. Gen. Warren R. Carter

Named Chief of Staff

BRIG. GEN. WARREN R. (NICK) CARTER, veteran of a quarter century in military aviation, and now chief of staff of the Gulf Coast Army Air Forces Training Center at Randolph Field, Tex., has spent much of his military aviation career associated with student flyer training activities. He served as flying instructor, flight commander and stage commander at Brooks Field from 1926 to 1931, and later was transferred to Randolph when that field was opened in 1931.

General Carter is a graduate of the Command and General Staff School. He is rated as a command pilot.

New Training Wrinkle

THE newest training wrinkle reported from west coast AAF schools is a parachute jump mock-up, which teaches cadets how to leave the cockpit and handle their parachute in an emergency.

NOT "WASHOUT," SON

(To Pvt. A. R. Petrucci, Goodfellow Field, Tex., author of "Washout," FLYING, December, 1942.)

Not washout, son, because the fates
Decreed you would not fly
Where hearts are tossed up high to meet
The portals of the sky

Perhaps because of your brave work
A plane will soar above
And save for you in days to come
The precious things you love

So as your comrade lifts his wings
Your heart vibrates the sound
Then do not be too sad because
Your work is on the ground

For flying there up in the blue
A pilot whispers, 'son,
I've fought the fight to-day because
Of work which you have done'

Then since it is decreed by fate
It is the better part
Because of you a flag flies high
Its imprint on your heart

—Dorothy Carroll Murray.
Morristown, N. J.

Aerial Gunners Needed

DO you want the opportunity to do the axis a lot of damage?

You can do this by volunteering for training as an aerial gunner in the Army Air Forces.

All that a soldier has to do to obtain the opportunity is to talk to his commanding officer. Qualified volunteers from the age of 18 to 30, inclusive, are being sought to attend the five-week training course conducted at Tyndall Field, the nation's largest aerial gunnery school, it is reported in the Lawson Field, Ga., "Tail Skid."

Upon completion of the course, if you've got the stuff it takes, you'll receive a pair of silver combat crew wings and a sergeant's chevrons. (If you are a specialist you will receive a staff sergeant rating.) And you'll receive flying pay—50 per cent additional to your base pay—because you'll be one of the crew of an Air Force bomber.

Men in any branch of the Army may apply to their commanding officer for a transfer to the gunnery school. Men in civilian life who are drafted may apply for gunnery school at the time of induction or any time later. Because the demand for skilled gunners is great, there doubtless will be little waiting after you apply before you are on the way to Tyndall Field.

To qualify for the school you must:

1. Be between the ages of 18 and 30, inclusive.
2. Be not more than 5 ft. 10 in. tall.
3. Weigh not more than 170 pounds.
4. Have at least a seventh grade education.
5. Have made a score of 85 or more on the Army general classification test.
6. Have made a passing grade of 80 or more on the mechanical aptitude test.
7. Be below the rank of staff sergeant.
8. Be a non-specialist (aircraft mechanics, radio and radar men and aircraft armorers excepted).
9. Take a new physical examination required of gunners.

Tell it to the Army!

IF you've got an idea that will revolutionize the Army in one day—forget it. It is a million-to-one shot that it won't work and the War Department has no time these days to dabble with panaceas. But if, in your basic training or while on your job, you ran across an idea which you think will improve the Army's techniques, weapons, military doctrine or organization, you are encouraged to make it known to the War Department.

With the steadily increasing number of men with specialized skills in the Army, it is anticipated that many suggestions of a technical nature will be received.

Piling Up Hours

A NORMAL-SIZED class of aviation cadets flies an average of 800,000 man-hours of cross-country flights during the nine weeks of basic training at Randolph Field, Tex.

The CIVILIAN INSTRUCTOR COMES THROUGH

Walking out to their Boeing "Caydet" (PT-17) trainers, the civilian instructor and his student discuss the day's work.

After flying, instructor grades his pupil on an Army form.

His battles are fought in a space no bigger than the front and rear cockpits of his open-air primary training airplane.

Photographs from U. S. Army Air Forces

by Capt.
ALLEN C. RANKIN

Captain Rankin served with the Coast Artillery Corps before transferring to the Army Air Forces. A Phi Beta Kappa from the University of Alabama, he later became a newspaper feature writer. Now a public relations officer at Maxwell Field, Ala., he is following an old hobby of his, aviation writing. He formerly was on the staff of the Montgomery, Ala., Advertiser.

NO MEDALS. No bands. No thanks. Yet as dusk fell over the flying field, the civilian instructor had scored another victory—a victory in psychology, in salesmanship and in driving across his message, man to man.

One more class of aviation cadets, beginning as raw dodoes at an elementary school in the Army Air Forces Southeast Training Center, had been seasoned, taught to fly, pushed up the road to combat. That tough hump—the first 60 hours of their flight training—was behind them. From now on, in subsequent flight courses, very few of them would drop out. Most of them would get through to tangle with the Jap and the German in foreign skies.

Enough about the cadets. They will write their own headlines at a later date. The instructors never will.

We drove to town with one instructor just down from a flight. He told us he had passed four out of five of his students. It had taken work, everything he had, but he had gotten them through. Five more students would be assigned to him next week, and the instructor would start over again from scratch. His was a never-ending job. His future held an infinite number of new students, who would learn their most important iessons in flying from the man who sat in the front cockpit and drove the dope home through a one-way, "no-talk-back," speaking tube.

We dropped into the corner drugstore for a snack and felt inquiring eyes on the instructor's civilian clothes. Mr. and Mrs. John Q. Public—who had a son in Australia—raised a curious eyebrow. A sergeant, home on furlough, looked over the

tall, rangy fellow and wondered why he was not in uniform.

Suddenly we wanted to tell them why. For this key man who has the backing and the confidence of the Air Forces, also should have the backing and understanding of the people. The civilian instructor *must* have it at this time; otherwise, he cannot continue to stand the numerous new strains under which he now labors.

Every day, the demand for more and more fighting pilots throws a greater load on the civilian instructor's shoulders. Every day, there is an increasing tendency to pack the future pilot with more knowledge and do it in less time than the day before. For instance, whereas the instructor used to teach the beginner only the fundamentals of flying in a certain time, he must now teach him instrument flying, cross-country and night-flying, in a shorter time and without appreciable increase in equipment.

Harry King (right) is the civilian flight instructor at the Army Air Forces training unit at Orangeburg, S. C. He is talking with Capt. John Wallace, Army commandant.

Only by battling ferociously has he been able to keep up with a merry-go-round of requirements whirling ever faster. Ironically, but logically, he gets fewer and fewer thanks.

Why logically? Because as his students' accomplishments become greater on the fighting fronts of the world, his comparatively colorless task slides farther into the background by simple contrast. Eventually the blazing fires of the very victories he helps to create will leave him and his role completely in darkness.

How does this fact sit with a hot-blooded, natural adventurer who has sought new thrills in the air, long before the war was mentioned? Not at all well, we assure you. The civilian instructor's first impulse is to throw up his job and head for combat, fast—especially after the monotony of teaching begins to play on his nerves.

But he must be brought to reason. First, what would the Air Forces do without him? If he followed his impulses, threw his job to the wind and dashed off to Libya, who would fill his place? The answer is an indelible question mark. . . . But let's begin at the beginning.

Back in 1939, when war pilot production was thrown in high gear, the Air Forces contracted with nine civilian flying schools to give cadets their first flight instruction and prepare them for advanced Army courses. Civilian elementary schools already were set up and operating when Army schools were still in blueprint. The Air Forces contracted with civilian school owners because they could do this more cheaply and, of course, more quickly than they could build such schools.

What was happening? The greatest wealth of civilian flying knowledge and equipment was being regimented in the blink of an eye. Not only could civilian contractors furnish much equipment, already geared for mass production; they could also furnish whole staffs of the country's most experienced flight instructors. They merely quit teaching pilot sportsmen in tweed suits, and quietly began teaching a great mass of serious-minded, fighting men in uniform.

There was only one radical change. Leisure and the luxury of personal idiosyncrasies were slashed from the program. All instructors must teach now only in one set way, "the Army way," in one ship—the Army ship. They must solo all students in 12 hours and make precision pilots of them in 60. The pressure was on.

Naturally the exacting methods of Army flying required exacting instructors. All civilian instructors who wished to teach Army men were given a 25 to 35 hour "refresher course" to qualify them for their new task. Less than 50 per cent of all instructors who entered this course ever made the grade. It was plain to see that good qualified instructors who could work exactingly under the hardest, fastest pressure ever known in aviation, soon would be at a premium.

That was 1939. Since that date, civilian contract schools have been grabbing up good instructors wherever and whenever they found them. Yet the supply has been not nearly so great as the demand. The pilot expansion program which leaped in its demands from 30,000 to 60,000 to 90,000 pilots a year, soon gobbled up men who were immediately available and, as these became scarce, began to throw the load more heavily on instructors already working to capacity. Today good instructors are rare birds, indeed.

How rare? At Hawthorne School of Aeronautics (under Air Forces contract at Orangeburg, S. C.) five letters are dispatched every day in desperate search of more instructors. From the three of them which are answered at all only one applicant finally shows up. And of the instructor classes composed of such hard-gotten applicants, only 50 per cent pass the "refresher course" and actually begin teaching cadets. These must constantly be talked out of their urge to run off and fight.

They *must* be dissuaded in this urge. For this war is not a matter of tossing masses of people immediately into combat positions. It is a long, drawn-out affair, and mobility—keeping the right men in the right places to keep the machine running smoothly—will win the war.

It is obvious that every good pilot cannot be a good instructor. Many of our best combat flyers would not have the temperament and the patience to teach class after class of men, giving to the last student the same minute attention as to the first.

The strain of combat flying comes in quick spurts, hard on the nerves. The strain of instructing comes in slow sieges lasting for months without let-up, trying the brain, the stamina and the ingenuity almost to the point of exhaustion.

An instructor must be a precise pilot, a good psychologist and a super-salesman rolled into one. He is primarily a good salesman from civilian days when he taught about 97 per cent of all his customers how to fly in one fashion or another. Good? He had to be good to make a living.

He picked up a bagful of tricks. His product was the air, the ozone, the great cloudy heights. And the first thing he had to do was to rid his prospect of all fear of it—to make him feel at home. This he did, not by yelling the facts into his student, but by gentle and subtle psychology. He learned the 10,000 little strategems of long experience. In the old days these paid dividends in cold cash.

Today they pay dividends in air power. On the instructor's knee board, which he wears strapped to his leg in the cockpit, is determined the ultimate size and quality of our Air Forces. Hundreds of ace pilots are out pumping lead into Zeros and Messerschmitts who would not be

(*Continued on page* 100)

IT TAKES SENSE TO FLY!

by JOHN R. HOYT

THE lightplane was taxied swiftly out, turned abruptly into the wind, and given full throttle. Nose high, it leaped into the air and commenced a steep, climbing turn until at barely 200 feet it was downwind with hardly enough airspeed to maintain its attitude.

"That guy doesn't have good sense," remarked more than one pilot who witnessed the showy take-off.

And yet their statement, true and applicable as it was, didn't tell more than half the story. True enough, the pilot lacked sense, or rather senses. It takes *sense* to fly, and more than one kind of sense at that. Even today, with airplanes that are so-called "fool-proof," a pilot can't hope to fly safely if he lacks some of the qualities about to be described.

Just what is flying sense? We've heard about piloting "by the seat of the pants," which has been more elegantly described as kinesthesia, or deep-muscle sense. Then with bigger planes and more instruments, we hear that this particular sense doesn't tell the whole story.

As far as we lightplane pilots are concerned, there are about five senses to use if we are to become an ordinary, safe, well-respected flyer. There may be more, but there are at least five, and every one of them must be used constantly if one is to survive. This doesn't mean that a movie-thriller accident will occur if the rules are broken, but rather that experience has indicated that those who break the rules are the ones who get the headlines—in accident reports.

The lightplane in its present stage of development is a contrivance that we fly primarily by *sight*, secondarily by feel. Every pilot can remember his first instruction rides, and the one lasting impression—vision. After that we remember how things felt—later, still other senses were used in learning to fly.

During the first few hours of instruction our main effort is to watch the nose and wing. We fly by seeing: first we notice the position of the nose and where it meets the horizon, how it creeps around the horizon when a good turn is made and where to hold it for a normal climb.

That is merely a beginning in the use of vision as an aid to safe flying. Later, often hundreds of hours later, pilots learn that they can use the eyes to greater advantage, as for example the use of the chord line of the wing in lieu of the nose.

The "chord line" is a term used to describe the apparent line one sees from the cockpit when he looks from the leading edge to the trailing edge of the wing. The surface of the wing, especially in a highwing monoplane or conventional biplane, forms a line that is called the chord line, although it may or may not be the actual chord of the airfoil.

The value in using this line is manifest on a foggy day with limited visibility. Almost everyone has had trouble in establishing his rate of climb when the horizon has been obscured—that is, everyone except the pilot who is using his senses to the utmost. For instance, suppose we are flying a lightplane, a highwing monoplane. Looking ahead we see the nose outlined against a greyish blur and no horizon line. Looking to the left we can plainly see the under surface of the wing, with the ground be-

Common sense, along with several other senses, is a requisite for any flyer, whether sportsman or military.

Flying like this is done by able flyers in ships like this Vultee liaison plane.

neath. The general line from leading edge to trailing edge (chord line) is practically horizontal in level flight; even on foggy days there is no difficulty in telling when the chord line is horizontal.

Now we can raise the nose to a normal climb, all the while watching the chord line. As the angle between the chord line and the ground increases it is easy to tell when we have reached the altitude we want—and to hold it there! *This is one of the most important reference points a pilot can use!* It works equally well in climb, level flight or glide.

Another feature of the chord line in "vision-sense" flight is that it does not vary with the size of cushion or 'chute a pilot happens to use; it doesn't vary because of smoke or fog, and even when the horizon disappears it is possible to fly as long as there is ground visible beneath. In half-mile visibility a climbing turn can be made by visual reference to the chord line even though the nose is pointed at a mass of nimbo-stratus.

It is a well-established fact that pilots cannot fly without seeing; "blind" or instrument flight *must* be performed with instruments, not by the senses. Yet here is a stunt that will prove not only how important the visual sense is, but how little the average pilot uses his eyes to full advantage. At a safe altitude and at a good distance from all other aircraft, put the plane into a bank of 45° and watch the chord line only. Do *not* use the nose for a reference line; in fact, don't look at it at all during the complete 360° turn. Use the chord line in determining the angle of attack and the correct attitude of the plane to maintain altitude. To your probable astonishment you'll find that the turn was the best you ever made, and that you'll maintain altitude within plus or minus 10 feet!

Vision—the first, most important sense—can be used in turns. Good co-ordination can be achieved by *watching* the rate of turn. Know your plane—at any airspeed the nose will turn so fast and no faster in a given bank. With the ball in the center, a turn will *look* right, and by combining vision and feel (a sense to be described below) better co-ordinated turns can be made than ever before.

Although the next "sense" is the least important in this list, it is not to be disregarded. As a student you were told to *listen* to the changes in the motor, the airflow and the accompanying vibrations peculiar to a stall. And yet so many pilots hear but disregard these very important warnings, climb steeply out of airports and sooner or later become the subject of a CAB report.

Hearing is valuable because it is a sense that will indicate the approach to a stall. Stalled climbs, glides or turns sound entirely different from normal flight; steep dives or hard pull-outs have peculiar sound effects, but just hearing them won't do any good until you've trained your ear not only to recognize them but to send a message to the brain

(*Continued on page* 128)

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

AOPA NEWS

The Aircraft Owners and Pilots Association, with Service Headquarters in the Michigan Square Building, Chicago, Ill., is a non-profit organization formed and composed of non-scheduled aircraft pilots and/or owners exclusively. The AOPA operates with a full-time professional staff and is the largest group of civilian pilots in the world. The views and statements of opinion contained in this column are those of the Aircraft Owners and Pilots Association and not necessarily those of FLYING. This column is edited by the staff of AOPA for its members and other interested parties. Special releases of a more confidential nature are additionally sent each month to all registered members.

BY the time this column appears in print a disappointing announcement may have been made regarding the Civil Air Patrol, for this month has indeed been one of unrest, punctuated by conflicting rumors. The AOPA Section (monthly, confidential bulletin sent to AOPA members) goes to press a week or 10 days after this column and may, therefore, carry more pleasant tidings.

It seems almost probable at this date that the Civil Air Patrol will be officially "retired" with honor sometime between the date of this writing and the date this copy will reach the hands of AOPA registered pilots and their interested friends.

Whether CAP activities and the pilots and planes who compose the more active sections of the CAP are to be absorbed into the armed forces to carry on their patrol activities is a question of considerable debate at this moment. The reasons for the "honorable retirement" which now seems imminent are also a matter of great conjecture.

Since we can offer nothing constructive on the basis of the fragmentary information now available, we shall defer further comment to the AOPA Section or to a special issue of the Washington Newsletter (mailed directly to AOPA pilots).

Also in a current state of flux is the form in which the CAA War Training Service pilot training (formerly known as CPTP) will emerge. We have already reported in the AOPA Newsletter the details of the changes which came about as a result of or in conjunction with the closing of enlistment opportunities in the Army and Navy. At the moment it would seem that the WTS has strong backing by the Navy. But the Army viewpoint is not clear nor do responsible officials at this moment know exactly what amount of support Army will give to future WTS programs.

It is believed by many that, if certain revisions are made in the training curriculum to satisfy Army standards, Army support will follow. The probability is

(*Continued on page* 139)

Although women instructors have been assigned an important role in WTS (formerly CPT) program, further "militarization" of program may cause their displacement.

Hans Groenhoff

A typical Zweng class. Man in center of back row is Lieut. Comm. P. V. H. Weems, another famed navigator.

Loomis Studio

Charles A. Zweng

NAVIGATING PROFESSOR

by KURT RAND

Getting airplanes from here to there, guided only by the sun, moon and stars, is a modern science pioneered by far-sighted men like Charlie Zweng.

THE sons of the rising sun are beginning to hear from some experienced sun-shooters, and Hitler's setting star is being accelerated by some young men who know all about star curves. Charlie Zweng's students are going into action.

Around the globe, wherever planes are needed by the Allied Nations, they're coming through on schedule despite radio blackouts, bad weather and enemy operations. Plotting the courses on many of these ferry trips are master navigators who first handled a sextant under the tutelage of Charles A. Zweng, and who hold a diploma from his Pan-American College of Celestial Air Navigation in the sunny San Fernando Valley of Southern California.

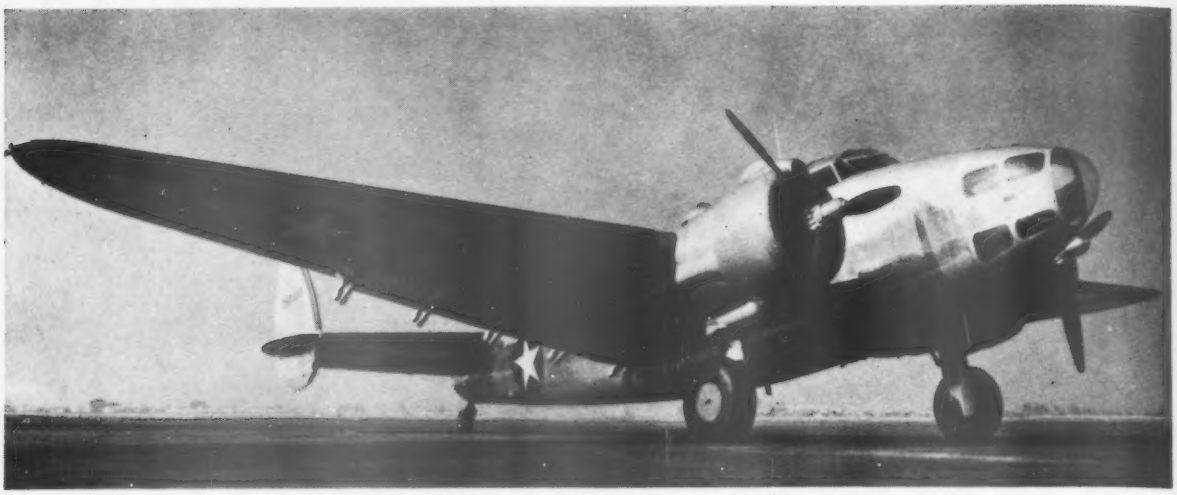
The P.A.C. of C.A.N. is Charlie Zweng's own personal contribution to the winning of the war. He built it and nursed it along through the slim days when celestial air navigators were required only by ocean flying stunt pilots. Now, when ferry services, airlines and the armed forces are crying for experienced navigators, Zweng has some of the men needed to fill the jobs.

He has poured thousands of dollars into his college, but the commercially minded reporter who visualizes the school as an educational gold mine will be swiftly disillusioned. Zweng runs it on such a non-profit basis that it regularly loses money. Students are charged tuition, but just enough to defray the expenses of the school and pay for the elaborate equipment used in the course.

Zweng's regular income is from the sale of his textbooks on aeronautical subjects. He has written and published 10 technical aviation texts and they have proved their value to such an extent that some of them have gone into as many as 14 printings. At the last count, 112,000 of his books had been sold to aeronautical students. Thousands of America's private pilots boned up for their written examination by studying Zweng's "Aeronautical Training," and his other publications are as well known in their respective fields.

Zweng writes, not for literary style, but in the hope of making flying safer, easier and more popular. Much of his

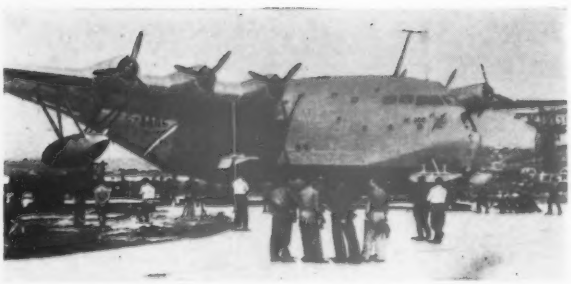
(*Continued on page 77*)



Minus its war paint, the Lockheed "Hudson" now is being used as a gunnery trainer. This trainer version, known as the AT-18, will be flown only in this country. Production of the "Hudson" bomber continues for both the AAF and RAF.

HAVE YOU SEEN?

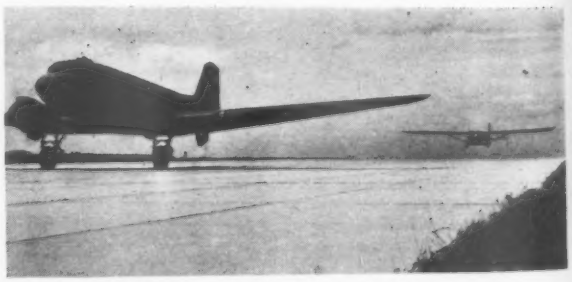
Navy plane being checked by inspection trainees may be new trainer or radio-controlled craft. Note nose wheel.



France's entrant for postwar air traffic is the "SE 200" with six engines developing 9,600 h.p. Huge craft weighs 63 tons.

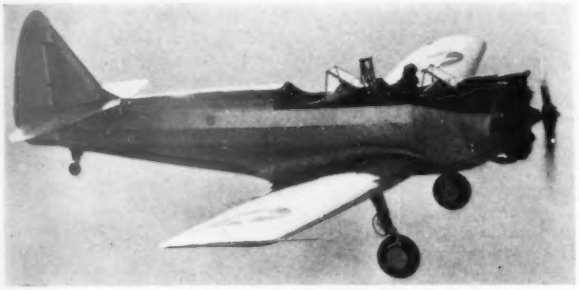
Brewster "Bermuda" for the RAF is powered with a 1,650 h.p. "Cyclone." Modification for the U. S. Navy is the "Buccaneer."

A four-bladed propeller, two radiators and a slight change in wing tapering, mark this newest of the RAF's "Spitfires."

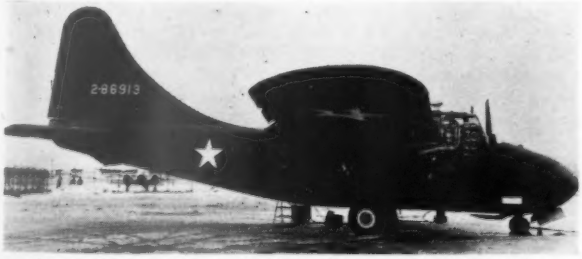


The Boeing CG-4, Army's 15-man troop glider, lifts easily into the air behind Douglas "Skytrain" in practice flight.

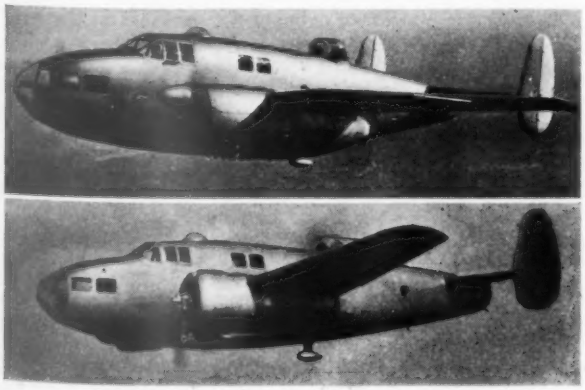
Hydraulically controlled dive brakes are the closest secret of this Vultee "Vengeance" (A-31) dive bomber. Their design gives the pilot almost perfect control in a dive. Power plant is an air-cooled 1,600 h.p. Wright "Double Cyclone" engine.



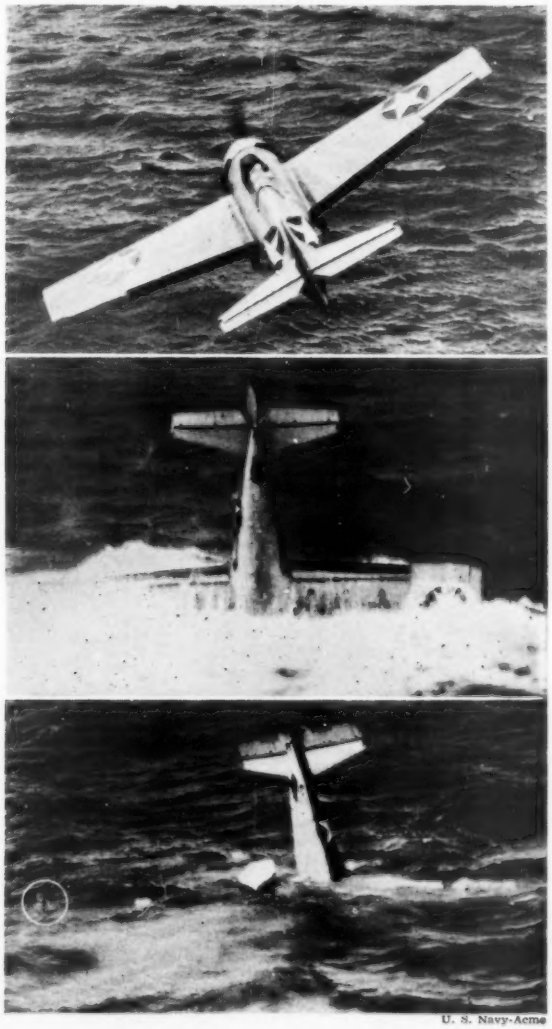
Aeronca now is manufacturing "Cornell" (PT-23) trainers, a Fairchild design under subcontract. The engine is a Warner.



First transport plane to be built almost entirely of wood, the Curtiss "Caravan" (C-76) mounts two 1,200 h.p. engines.



Fairchild has designed a new addition to their AT-13 bomber crew trainer (bottom) in the AT-14 (top). Main difference is the new ship is powered with Ranger engines.



U. S. Navy-Acme

This unusual series of pictures shows a Marine Corps Grumman "Wildcat" an instant after a carrier's arresting gear cable broke during a landing. The pilot (circle) tried to take off again, but stalled and nosed down into the ocean.

Industry Row

ABILITY of leaders of the aviation industry to get along with each other has been put on trial by a sudden row within the Aeronautical Chamber of Commerce of America.

The resignation in October of a group of Southern California manufacturers, led by North American, was followed by the resignations of most of the other leading figures in the industry. It precipitated the most serious of a string of crises faced by the Chamber since it was formed 21 years ago.

Some sort of a settlement was looked for at or before the Chamber's annual meeting, scheduled for December 3 in New York City—possibly "streamlining" the organization in a number of particulars. But in the meantime the row provided the entire aviation industry with a puzzle.

The most persistent speculation laid the walkout to a clash of sectional interests, dissatisfaction with the Chamber's form of organization and possibly its policies, to personalities and to "war nerves." Whatever the actual explanation, this is the background:

Organized in 1921 to represent all national interests of the aircraft industry, the Chamber has weathered a number of storms as aviation gradually expanded and then mushroomed with the approach of war. Martin was a holdout until two years ago, entering the organization coincident with an expansion of its publicity functions. Since 1940, the Chamber has tripled its staff to some 50 persons, undertaking to keep the industry advised on special legislation and labor developments, fostering efforts to standardize parts, trying to keep abreast of such difficulties as priorities and attempting to maintain public good will with conservative methods of publicity directed by Howard Mingos.

A sign of sectionalism appeared with the formation last spring of the West Coast Aircraft Production Council [FLYING, November, 1942], followed this fall by a similar organization of East Coast manufacturers with the same ostensible purpose of exchanging technical information to speed work on war orders. But all was serene when the Chamber's executive committee held a session in mid-October. President John H. Jouett was given a pay increase, which seemed to imply a vote of confidence, and Robert P. Newton, of Denver, recently of the War Production Board, was made senior vice president to lighten Jouett's load of executive duties.

Then, out of a clear sky, came the sudden resignations a few days later of North American, Consolidated, Vultee and Northrop, with North American's president, J. H. "Dutch" Kindleberger, leading the van. Inquirers were told these companies were just generally dissatisfied, did not consider they were getting their money's worth from the assessments they paid. The burden of these assess-

(*Continued on page* 138)

FROM HEADQUARTERS

by Lieut. Col. HAROLD E. HARTNEY, Army of the U. S. (Inactive)

Harold E. Hartney

EVERYONE welcomes the new policy of Army and Navy, listing the types of our planes by names instead of alphabetical designations. How much better to have everyone using the name *Liberator*, instead of having the Army call it the B-24 and the Navy and Marine Corps the PB4Y. How much better to call the Douglas light bomber the *Havoc*, instead of the Army A-20 and the Navy BD. Before long, the Republic P-47, with its eight .50 caliber machine guns, will be literally sawing enemy aircraft in two. How much more fitting to name it the *Thunderbolt*. The Messerschmitt, Focke-Wulf and Zero will appear sand-lot stuff in big league play!

* * *

Two good books for you since last writing: "Wings Over America" by Harry Bruno and "The Fight for Air Power" by W. B. Huie. Both are *musts* for anyone who plans on a career in aviation.

* * *

Another "must" are the 10 commandments of Gill Robb Wilson, president of the National Aeronautic Association, called "What Can I Do to Help?" It is a small one-page poster and I keep it on the wall in front of me. Among other admonitions is: "Thou shalt stay out of Washington." Evidently the civilian agencies here agree with this, for they have thrown up guards for themselves a la Army and Navy, making it so difficult to gain admittance that one would think people down here actually relish the job of calling on them in these busy times.

* * *

Who is going to call a halt to some of the silly, petty things that go on in the overflow training program? For example, in the CAA's War Training Service (formerly CPT), they claim that it will be impossible to train both Army and Navy trainees, one reason being that the former has a circular or oval traffic pattern, whereas the latter has one that is rectangular. Is it any wonder our elders feel that flyers will never grow up?

* * *

The British Empire has several independent and efficient air forces. Each has its own uniform, promotion list and traditions. There are the Royal Air Force, the Royal Canadian Air Force, the Royal Australian Air Force, the Royal Indian Air Force, the South African Air Force and the Royal New Zealand Air Force. Each is as separate and distinct from each other or from the army and navy of their respective commonwealth as is our Army from our Navy. In fact, the RCAF has 2,000 airmen in the Middle East alone, and has recently set up a Middle East establishment with administrative personnel, auxiliary services and officers and men of other specialist categories. Some Canadian navigators, aerial gunners and radiomen (called "wireless operators") are serving temporarily with our own U. S. Army Air Forces.

* * *

Birds of a feather flock together. So do flyers. They work in greater harmony and get results. When the three branches —Army, Navy and Air—are of equal status, it's a cinch to obtain unity of command, no matter what the genesis of the commanding general and his staff.

* * *

The true picture of air power in this war today is becoming clearer. The picture is somewhat like a negative one develops slowly in the darkroom. Here are some of the items of that negative:

An American aviation industry backed up by a half hundred billion dollar war industry. From these tremendous plants will come *Flying Fortresses* capable of flying half again as fast as Civil War cannon balls—300 m.p.h.—nonstop from New York to Paris. These planes will carry a bomb load of eight tons.

Round-the-clock-bombings which will keep the foe on edge day and night, week by week and month by month. This product of the *Flying Fortress* and other giant bombing planes will shatter morale and destroy enemy supply lines.

Perhaps in the background of this negative, but playing just as important part, is the development of the huge cargo carrying plane. Day in and day out these flying boxcars will shuttle war goods from the factory to the front.

This picture, too, includes the training of vast armies of pilots, observers, gunners and ground crewmen. Fighters, observation planes, trainers and all ground equipment are part of the picture.

* * *

There are indications that when the veil is lifted over Germany to reveal the damage done by large-scale bombing, as recommended in the "Ziff Plan," the picture will be more shocking than that which we received when, one year after Pearl Harbor, details were given out.

So many locomotives have been destroyed by bombing that the new locomotive program of construction has reduced the German's tank-building program. Plant dislocation has been so great that the Germans are moving them back towards Russia. Stalin, however, may soon start bombing from the eastern rim and so catch the Nazis "coming and going." None of the expected oil is coming into Germany from Russia because of transportation disruption coupled with the failure in the Caucasus.

END

The Nose of the Airfoil

by RAOUL J. HOFFMAN

EVERY detail of an airplane contributes to the performance characteristics, especially the wing. The wing should give highest top speed and lowest landing speed. It should have an easy recovery from a spin. It should also require a minimum area for control surfaces and a minimum weight for a safe structure. As always there is no super wing having the qualities of an undisturbed airflow at all angles of attack.

In Section 1 the airflow lines over an airfoil at a low and a high angle of attack are illustrated. The region of turbulency increases with the increase of the angle. This turbulency reduces the pressure or suction towards the trailing edge of the wing as shown on a conventional airfoil in Section 2. The pressure distribution on a poorly designed airfoil and on a flat plate is plotted in Section 3. These pressure patterns show that the highest forces are on the nose of the wing. This indicates that the nose of the wing has a definite influence on the airflow and thus on the performances of a plane.

On a conventional airfoil the airstream follows the curvature of the surface up to a point where it breaks away as shown in Section 4. This point is the transition point. Up to this point the flow is laminary. From then on the airflow becomes turbulent and with increase of angle the transition point moves forward.

A layer of air sticks to the upper surface of the wing up to the transition point; a layer that is not in motion. This layer is called the boundary layer. At high speeds this layer is about 1/1000 of an inch thick. This may discard the story heard about a fly walking on a wing traveling 200 m.p.h.

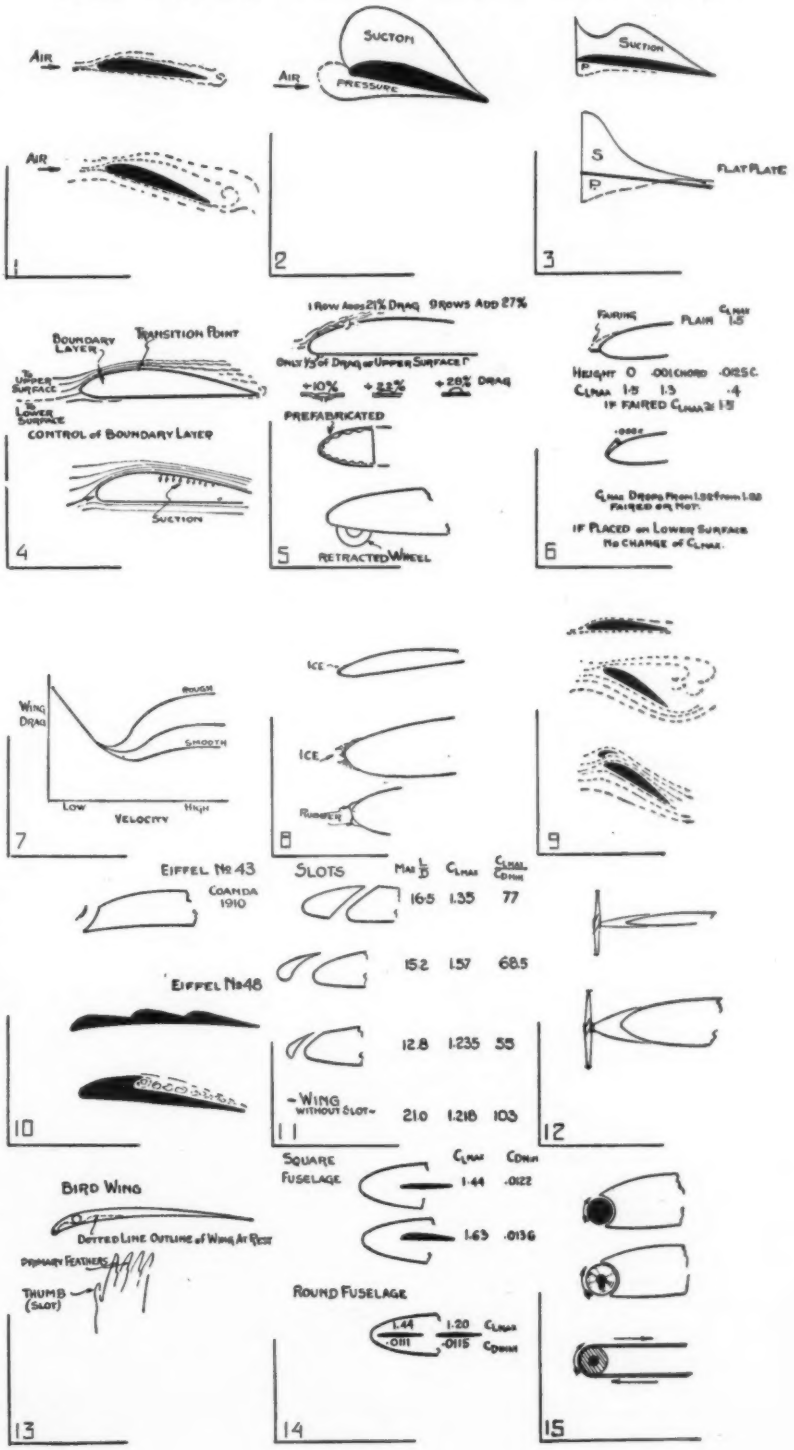
The airflow reaching the wing parts at the leading edge; one portion goes over the upper surface and the remainder passes under the lower surface. This dividing line is marked in Section 4. This parting line does not change substantially on a thin-nosed airfoil with change of angle of attack. On a blunt-nosed airfoil the parting line moves to the rear with increase of the angle, therefore the lift will increase to a maximum not obtainable with a thin-nosed airfoil section.

Tests made on thin-nosed (0012T) and blunt-nosed (0012B) sections shows that the maximum lift coefficient for the B-section is 1.50 and for the T-sections 1.05. The gliding angle for the B-section is 20.5 and for the T-section 21.5. The leading edge radius for the basic section is 1.58 per cent of the chord, for the B-section 3.80 and for the T-section .40 per cent of the chord.

The thickness of the boundary layer depends on the speed of the plane. Therefore the higher the speed the smoother the surface of the wing must

(*Continued on page* 149)

Engineers through the years have contributed many innovations to airfoil design.



I LEARNED ABOUT FLYING FROM THAT!—No. 43

by F. H. CHRISTENSEN

Now the general manager of Douglas Aircraft's Tulsa plant, F. H. Christensen has been an airplane owner, charter and barnstorming pilot, a freighter for the Forest Service, and a demonstration flyer for the early Aeronca two-place lightplanes. In 1934, after operating more or less as his own boss, Mr. Christensen went with the Douglas company. He now owns a Piper "Cub Coupe."

Some pilots are careless about using their safety belts. Here is the story of one flyer who learned his lesson in a storm.

"TEX" RANKIN taught me to fly in 1928 at the old Rankin Airport in Portland, Ore., but I did not *learn* all the lessons until various later dates. The first time Tex put me in the cockpit of a plane he showed me how to adjust the safety belt and told me that if I wanted to fly long and safely to never take off without first seeing that the safety belt was in perfect condition and *fastened on me.*

One morning in the early part of May I was picking strawberries in my garden at Pocatello, Ida., when my wife called me to the telephone. E. L. "Andy" Anderson, local manager for National Parks Airways, was calling to tell me that two men from Burley, Ida., were there at the port. These men were in a hurry to get to Salt Lake City, in time to catch United Air Lines' next eastbound trip. Andy said he would get my airplane, a Fokker *Super Universal*, out and ready for me by the time I could get to the airport. We agreed to a charge for the trip and I was on my way in a very few minutes. When I arrived at the airport the plane was serviced, the engine warmed up and the passengers were in the cabin waiting for me.

The trip south was successful and uneventful. After seeing my passengers off on the eastbound airliner, I leisurely ate lunch at the airport coffee shop and visited with friends and acquaintances.

About 3 p.m. I started back to Pocatello. The weather report was scattered thunderstorms. After I was on my way, I noticed the sky looked fairly squally to the west and northwest. By the time I arrived over Ogden, I could see a treacherous looking thunderstorm to the west of the area between Plymouth and Malad. I eased over to the east, and passed just to the west of Logan, Utah. Here I could see another black storm over Montpelier, Ida., and the entire mountainous area to the north of me was spotted with rapidly forming thunderheads. At Preston, Ida., I detoured still farther to the east to pass over Grace, Ida. Up to this time I had been so busy experiencing the radiance of nature's green hills, stony grey mountains, fancy work of brilliant colored flowers, spots of blue sky and the wild turbulent beauty of the clouds, that I had failed to realize the growing seriousness of the situation. I casually reached for the safety belt, but could not get it. The end of the belt and the buckle had worked through a crack in the floor at the end of the oil tank. I suddenly remembered I had not had my safety belt fastened for at least six months, doing all types of flying, during all kinds of weather. Try as I would I could not loosen the belt from the crack it had so tightly worked into.

The ship was being tossed about in a most violent manner, due to the turbulent air currents. The escape hatch handle was beating a tattoo on my head. I tried to hold myself in the seat with one hand, hang onto the stick with the other and keep my feet on the rudder. One

(*Continued on page* 141)

F. H. Christensen

Two New Japs

A REPORT of two new Japanese fighter planes, with greater speed and other points of superiority over the famed Zero, was brought to Washington by Maj. David L. "Tex" Hill, an AVG "Flying Tiger" ace and member of the China Air Task Force. These are two among several reported coming into combat service.

The two planes, identified only as the 97-2 and the I-45, had design characteristics which suggested they might be Japanese versions of German Messerschmitt craft, modified considerably to use radial air-cooled instead of in-line liquid-cooled engines.

Hill described the 97-2 as a single-engine, single-seat fighter, with somewhat greater speed—280 m.p.h. or better under usual combat conditions at average combat altitude of 13,000-18,000 feet—and with better diving characteristics than the Zero, indicating a somewhat sturdier construction.

Some of the pilots in General Chennault's China Air Task Force thought the Japs had acquired some Me-109's from their German allies, said Hill, but "I think probably they were confused by the shape of the fuselage."

As to performance, Hill credited the 97-2 with about the same characteristics as the Zero, except for the improvements in speed and in diving ability. Armament was not standard, some having machine guns of varying caliber, others mounting 20 mm. cannon.

The old Jap fighter 97 was a Nakajima which first went into production in 1937. It was a blunt-nosed, low-wing job with a single 750 h.p. radial engine that gave it a maximum speed of about 280 m.p.h. at critical altitude, but a normal speed of considerably less. Its range was limited, as was armament—three machine guns.

Although the Zero replaced it in 1940 as the standard production model for both army and navy use, the Japs apparently still use some of the old 97's—Hill reported encountering old fixed-landing-gear fighters in some recent combats in China. Despite its limitations, he said, the old 97 had its points—"the one I flew about 1940 was a fairly sturdy plane."

The twin-engine I-45 bore considerable resemblance to an Me-110, Hill reported, again allowing for the changes necessary in the design to permit the installation of air-cooled instead of liquid-cooled power plants. Although in use "since the start" as a reconnaissance plane, he said, it made its first appearance in a fighter version only last June.

This plane Hill described as being "very fast," and possessing very high altitude characteristics, operating at 35,000 feet or better and—in the reconnaissance version—sometimes "coming over so high we couldn't see them." The AVG ace thought it was highly unlikely that the Japs as yet had any turbosuperchargers, but suggested that the I-45 might be equipped with mechanical superchargers of the two stage blower type.

(*Continued on page* 126)

"Eyes of the Artillery" ... PIPER L-4

THE Piper L-4 plane is already proving its worth as the "Eyes of the Artillery" on the fighting fronts. Called the "Grasshopper" by artillerymen, the L-4 does a job greatly superior to the vulnerable observation balloons of the last war . . . and with relative safety!

The observer radios firing corrections to the battery until the guns are dropping shells directly on the target. The "Grasshopper's" protection is low-altitude flying, its ability to land quickly almost anywhere, the ease with which it can be hidden and the fact that it is practically invisible from above, even when in flight!

Its uses are not limited to the Artillery. It is now serving Uncle Sam in the Tank Corps, Cavalry and Infantry . . . directing troop movements, transporting officer personnel, delivering messages and spotting enemy infiltration.

And, when victory is won, you will benefit by a smart, easy-to-fly peacetime version of this remarkable plane. You'll be able to make quick, safe, restful flights to your favorite hunting, fishing and vacation spots, and streamline your business trips . . . saving time, gasoline and tires.

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- ☐ FUNDAMENTALS OF AERONAUTICAL ENGINEERING

Name.....*Age*.....

Address.....

City.....*State*.....

Letters

Factual Report

Sirs:

I have been a constant reader of FLYING for quite some time and have enjoyed reading your interesting comments under the heading "At Deadline." I couldn't help but feel that there was some injustice in one of your comments in the January issue, in which you referred to a mid-air collision between an airliner and an Army plane somewhere in the midwest. You stated: "Not long ago an airliner in the middle west, flying on instruments on civil airways—having reported its position, altitude and speed to airway traffic control—suddenly had its tail chewed up by an Army plane that also was flying on instruments at the same time and place—but without knowledge of either the airliner or airways traffic control. The airliner—it had three test pilots aboard—dove into the ground and was wrecked. By some miracle the three pilots suffered only minor injuries."

If you are referring to the mid-air collision on November 4, 1942 (time 11:50) between a C-53 Army Douglas and a TWA Douglas training ship, over the Kansas City radio range station—while both craft were on instruments—your report couldn't possibly be farther from the real truth, and I'm inclined to believe your source of information must have been from ATC and TWA news reports, and certainly not taken from the reports given by the two boards of investigation, the first of which was made up of the Safety Board—members and the chairman sent out from Washington—and the second of which constituted a Congressional investigation.

. . . That the Army was . . . flying in accordance with rules and regulations . . . was shown . . . by its flight clearance and flight plan . . . from Stout Field, Ind., up until the time of the accident.

The airliner was a . . . TWA training ship used . . . at Kansas City airport to check out new captains for the air line. It had been operating that morning in the Kansas City area on instrument and range work. At the time ATC cleared the TWA ship to take off and proceed to cross the northeast leg of the KC range, it also had knowledge of the cruising altitude and estimated time over of the Army plane, but took it for granted that the Army ship had passed over because it was a few minutes overdue (it being five minutes overdue at the time of the accident) and no position report had been made by either aircraft, at least not since the TWA ship had taken off. The position report of the Army C-53 was about to be given when the collision occurred, a mile or so from the range station, as was evidenced by parts of both aircraft which were found on the ground later.

I might add that the airliner had aboard two student first officers . . . and a TWA captain who was giving instrument flight instructions to them, and that they were *not* "test pilots." The pilot of the Army plane, a former American Airlines captain, landed the ship safely at the Kansas City municipal airport after having 10 feet knocked off the right wing in the impact with the vertical fin on the TWA ship. Three more feet on the leading edge of that wing were badly crushed in. Luckily enough the occupants of *neither* ship were injured, except for slight shock in the case of the TWA captain.

. . . I am . . . of the opinion that ATC could do with a few new policies . . . so that both Army and airline ships would have knowledge of airway traffic in their vicinity while on civil airways.

For your information, I was co-pilot on the Army C-53 . . . and later was present at both investigations.

OBERT C. BURRELL,
Lieutenant, Air Corps.,
38th Troop Carrier Squadron,
Sedalia Air Field.

Warrensburg, Mo.

● Many thanks to Lieutenant Burrell for setting us straight. Unfortunately, we could get but a second-hand view of the affair, and that was through (as Lieutenant Burrell guessed) an airline source. —ED.

Women Pilots

Sirs:

As an old subscriber looking for the truth in all articles . . . and wishing to have statements concerning women in aviation beyond criticism, I am calling your attention to a misstatement in the article "The Ladies Join the Air Force" [December, 1942]. On page 96 it states that Miss Cochran "became the only woman to compete in the Bendix." This, of course, is not true and I know Miss Cochran would call attention to the error if she noticed it. You will . . . recall that Louise Thaden had won the Bendix a year previous to Miss Cochran's first entry. Amelia Earhart had also flown in the Bendix. . . .

I would call attention to the fact that many women in the United States have more hours than those mentioned [in the article] and have commercial licenses, but are over the age limit. . . .

FLORENCE H. BOSWELL, R.N.
Chairman, All-Ohio Chapter,
Ninety-Nines.

Cleveland, O.

● Our apologies to pilot Florence Boswell who, with 1,650 logged hours in addition to a non-scheduled instrument rating since April, 1937, ranks as one of the most experienced of the country's women flyers; and to Louise Thaden, winner of the 1936 Bendix.—ED.

(Continued on page 145)

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Standard Equipment
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So we're looking forward to the day, not so far off, when you'll come flying back to us and become a part of peace-time aviation—a great industry whose future is being born today. There will be a job waiting for you! Meanwhile . . . our love and Happy Landings, Son!

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TEST EXPERTS

by

WILLIAM F. BONI

Wide World

Experts in locating the "bugs" in aircraft fresh off the assembly line, these test pilots of Lockheed-Vega study celestial navigation during their non-flying hours.

IT is, probably, the most incongruous place you could find in the entire aircraft industry—this old Spanish ranch house, test pilot headquarters for the Lockheed and Vega companies.

Complete with patio and fountains, shaded by graceful eucalyptus trees, the hacienda stands right at the edge of the Lockheed Air Terminal, Burbank, Calif., where transports for east and north make their headquarters and where the air is filled constantly with the roar of *Lightnings, Hudsons* and *Venturas.*

On two sides this hacienda is flanked by runways. On the third is the crowded parking lot for the flyers—50 first pilots, 26 co-pilots. On the fourth, 100 yards away, is the hangar in which the Army Air Forces' P-38's come in for repairs or adjustments and where, at one blocked-off end, the final touches are being put on Lockheed's cargo-carrying giant, the *Constellation* [see page 35].

Despite its air of withdrawal from this incessant hubbub, the ranch house would surprise you. It is a businesslike place, from the two efficient young ladies who run the switchboard to the upstairs rooms which have been converted into offices, operations headquarters, classrooms for instruction in celestial navigation, and lounges where the pilots can relax between flights.

Downstairs, just off the entrance hall, is a large room where the hacienda's former owner, a millionaire, probably gave lavish dinner parties. Now it houses a Link Trainer, in which each pilot on the staff must spend at least half of the two hours of instrument flying which are required each month.

The movies portray these men as daredevils who spend each waking hour putting planes through power dives and screaming pullouts, barrel rolls and all the other tricks of a stunt-flyer's trade. They—starting with Elmer C. McLeod, their 40-year-old acting chief—regard themselves as business men whose business it is to see that each plane which comes from the plant is ready for the job it was designed to do.

It keeps them busy, too. The 76 men on the Burbank staff, over a five-month period, have averaged a flight every 11 minutes, 10 hours a day, seven days a week. They will average 85 to 125 flights a day (one day there were 141, representing 82 hours and one minute flying time) and their proudest boast is twofold—that in company history only two planes have been lost through pilot error, and that since 1932, only two test pilots have been killed.

Like the flyers employed by other aircraft manufacturers, most of these men are airline veterans. Some, like Ray Little and Bill Dougan, were aces in the first World War. Jim Allison flew combat planes in Spain and in China. Jimmy Mattern you may remember as the man who flew non-stop from Newfoundland to Berlin in 1932, and a year later was lost for 14 days in Arctic Siberia on an attempted round-the-world solo.

Milo Burcham, born in Cadiz, Ind., 39 years ago, spends most of his flying time in 400-M.P.H. P-38's, most of his driving time in a model A Ford. He once set a record by flying upside-down for more than four hours. Lewis D. Parker, called "Swede" for his close-cropped blond hair and ruddy complexion, is a Harvard graduate who wrote music for the Hasty Pudding Club shows, and has been to Singapore and to Australia with *Hudson* bombers.

McLeod, whose hair is shot with silver, has been with Lockheed for seven years. In that time he has made three flights around the world and 22 to South America, and twice delivered Lockheed "12's" to the Rajah of Jodhpur, staying at the palace for two months the first time, until the Rajah had learned to solo.

Currey Sanders built and flew his first plane at 14, landing smack in a soft drink stand at a Shreveport, La., fair. Now he bosses the pilots at a modification base "somewhere in the southwest" where last-minute changes, ordered after the planes had left Burbank, are incorporated in them before they go on to operational or training bases.

In addition to these men, there are five more on overseas duty, where they work on a pool arrangement with other companies' pilots and thus get to fly just about everything the Allies are making these days.

All of them would prefer not to be called test pilots. Instead they either are engineering pilots, who take planes up to check certain new devices installed by the engineering department, or they are production pilots, who give the planes an overall check—two flights for each ship—before the Army takes over for the final acceptance flight.

The Lockheed gang prides itself on the fact that the Army has empowered them to make acceptance flights—thinks enough of them, in other words, to take delivery on their say-so.

Occasionally they do the stuff of which test-piloting fiction is made. The first plane of a new type, or the first of an older type which has undergone a structural change, must be "given the works" in order to apply full stress to each part.

The rest of it they regard as routine business, though a mechanical failure like exhaust gas leaking into the cockpit or an engine cutting out may add an extra hazard now and then. Part of the time, too, they are breaking in new pilots or "checking out" co-pilots who have had sufficient time to qualify as first pilots.

Because all are experienced—two years ago the staff's total flying time equalled seven full years in the air—even taking up a "hot" ship like the P-38 for the first time isn't considered anything special.

Before his first flight in one of these high-altitude fighters, a man gets some two and a half to three hours of cockpit instruction so he'll be familiar with all the controls and instruments. When he does go up, he generally will be given a plane which already has been flown and found good by another pilot. From there out, he's on his own.

END

WARTIME AIR INSURANCE

by FRED C. CROWELL, Jr.

Aircraft used in essential war work are covered by a gigantic insurance pool directed from Washington.

An insurance arrangement has been set up for these CAP pilots.

AS more and more civilian pilots and planes are being pressed into service by the Government, both for pre-training and for various patrol duties, the civilian aviation picture is a rapidly changing one. Following in step with this changing picture is the aviation insurance industry.

Outside of the construction business, which has been loaded with huge Government contracts, civilian aviation is the only classification within the entire insurance industry for which a super pool has been created in Washington in connection with war work.

To take care of the insurance requirements of both the War Training Service Program and the Civil Air Patrol, every insurance company writing aviation insurance has joined in the super pool and has become an insurer under master policies filed in Washington through the three competing pools which have served aviation interests for some time. Thus we see three established aviation insurance markets joining together to form a super pool of tremendous proportions and capable of withstanding any catastrophic loss.

The provisions under which the competing markets now operate in connection with War Training Service [Civilian Pilot Training Program] insurance and Civil Air Patrol insurance require that the premiums and losses be equally divided among all the participating companies, with the exception of a certain percentage which goes to the company or group originating the business and is meant to take care of overhead expenses.

It is interesting to note that in many respects this plan is practically the same as that which was recently adopted for the issuance of war damage insurance by the War Damage Insurance Corporation. The stability of the market is thus established beyond any question. In the case of war damage insurance the fire insurance companies do not retain any of the liability, whereas in the case of the aviation insurance the liability is retained and shared by the established underwriters.

Actually the super pool is not new because the first master policies were filed some three years ago when the then-Civilian Pilot Training Program was getting its start. What is fairly new is the insurance arrangement for the Civil Air Patrol.

Required insurance coverages under the WTS include personal accident insurance and public liability and property damage insurance. The former consists of $3,000 death and dismemberment coverage and $1,000 medical reimbursement for each student. This personal accident insurance protects the student while flying, going to, being at and returning from the airport and ground school classes, but only in connection with his duties as a WTS enrollee. Students enrolled in the private non-college course are not protected in connection with ground school classes.

The latter coverage consists of public liability insurance in the amount of $50,000 to $100,000 and property damage in the amount of $5,000. This protects the interests of the flight operator, the sponsoring institution, the Civil Aeronautics Administration and the student.

In the Civil Air Patrol there are comparatively few civilian pilots on active patrol duty. In connection with the Civil Air Patrol, however, all pilots are not required to carry a liability policy. The present ruling is that only those pilots who are being paid for their patrol services are required to furnish such evidence of financial responsibility. Undoubtedly the time is not far off, however, when a great many more civilian pilots will be pressed into active duty on submarine patrol, forest fire patrol and courier service.

Unlike the War Training Service, the Civil Air Patrol, in connection with paid missions, requires only public liability and property damage insurance. Personal accident insurance is not required but is available.

There are now on file in Washington three master policies on the Civil Air Patrol. They include policies on public liability and property damage insurance, accident insurance and hull insurance in flight and on the ground. It is understood that also at the present time a special crash policy is being written on the pilots and observers in connection with the few ships which are today on active duty on East Coast submarine patrol work. This special insurance is being written on an hourly flying basis.

The public liability and property damage master policy was issued March 2, 1942. The other two master policies in the super pool were filed as of June 1, 1942, and the insurance is effective for those pilots who make Civil Air Patrol flights at the request of, and with funds furnished by, any federal or state government of the U.S. or any subdivision, unit, department or agency thereof.

The terms and conditions of these policies have been bulletined to all Civil Air Patrol unit commanders by Civil Air Patrol headquarters, or through local Civil Air Patrol units.

The public liability insurance differs from that issued for the WTS in that it also contains, by requirement, liability to passengers—provided the pilot has 150 hours solo flying to his credit, 50 hours of which shall have been cross-country flying and 10 hours of which must have been completed in the six months prior to the pilot's Civil Air Patrol duty.

Certificates showing that such insurance is in force are issued by the underwriters to the pilots, and it should be emphasized that insurance is not in effect until such certificates have been validated by the insurer. Such valida-

(*Continued on page* 134)

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Speed Nuts THE FASTEST THING IN FASTENINGS! Speed Clips

Safety Sleuths

(*Continued from page 38*)

When the on-the-scene investigation has been completed—and it may last for days—the probers check all the various operating data, such as weather information and flight plans. Finally, after all the evidence has been gathered, it is carefully studied. The findings are prepared by the Safety Bureau for the Civil Aeronautics Board, which then prepares a public report listing the probable cause and giving supporting data.

Sometimes further action is necessary. For example, if flaws in operating procedure are uncovered, regulations are prescribed to eliminate them. Occasionally, changes in aircraft construction or appurtenances are ordered.

That red and white flashing tail light on present-day commercial planes is an outgrowth of an accident investigation. The CAB decided that planes should have a more distinctive rear light after the pilot of a plane about to take off from the Wichita, Kan., airport mistook the conventional red tail light on another craft for a field boundary light and taxied into it.

A fine example of the kind of real detective work accomplished by the accident investigators is the manner in which they follow the "trail" of an errant little machine screw that jammed the elevators of a multi-engined plane and caused a crash. Because of its connection with the war effort, names, places and dates must necessarily be withheld.

But the plane involved had been flown 10 to 12 hours in tests and was on another test flight when it began a strange series of maneuvers. First, it shot straight up to the stall point and then dove, evidently without power. Just before reaching the ground, it shot up again and then nosed down, plunging into the water nearby.

The investigators put canvas slings under the various pieces of wreckage and hauled them out of the water. In one of these slings, they found a machine screw, 5/8 of an inch long and 1/8 inch in diameter. But nothing was too minute or seemingly unimportant to be overlooked by the examiners.

The screw was found to have peculiar markings which were examined under a microscope. Then, following the method employed in ballistic tests, they looked for markings in the control system of the plane. Microphotographs were taken and it was found that the markings in the control system corresponded with those on the screw. Thus it was possible to trace the course of the tiny metal bit.

The investigators not only found the cause of the accident but they learned how it was possible for the screw to have gone awandering during the building of the airplane. Manufacturers were promptly notified of the findings and recommendations made to prevent recurrence.

Planes have been taken up by investigators in risky attempts to simulate what may have occurred on another similar, but ill-fated craft. Once, during such an experiment, a motion picture photographer was taken along to record on films the action of various instruments. Incidentally, he demanded and got $150 before climbing into the plane for the brief, but potentially perilous flight.

The airline crash at Lovettsville, Va., on Aug. 31, 1940, taxed the ingenuity of the investigators because the plane was shattered into a thousand pieces in the accident. Nevertheless, they were able to amass a great deal of information concerning the behavior of the engines —although engine failure was not listed as the probable cause of the accident.

Rummaging through the mass of wreckage, the probers salvaged master rod bearings, knuckle pin bushings, piston pin bushings and knuckle pins. Examination showed them to be damaged. Their condition, the experts deduced, could have been caused by a momentary interruption of the oil supply or by an overloading of the bearings. Since either of these might have been caused by over-revving of the engines, an extensive series of tests was undertaken.

The experts found that over-revving in excess of 3,000 r.p.m. had taken place in the engines. The overspeed tests showed that the oil film would have remained intact for bearing loads imposed by an engine speed of at least 3,000 r.p.m., so oil supply interruption was eliminated as a cause.

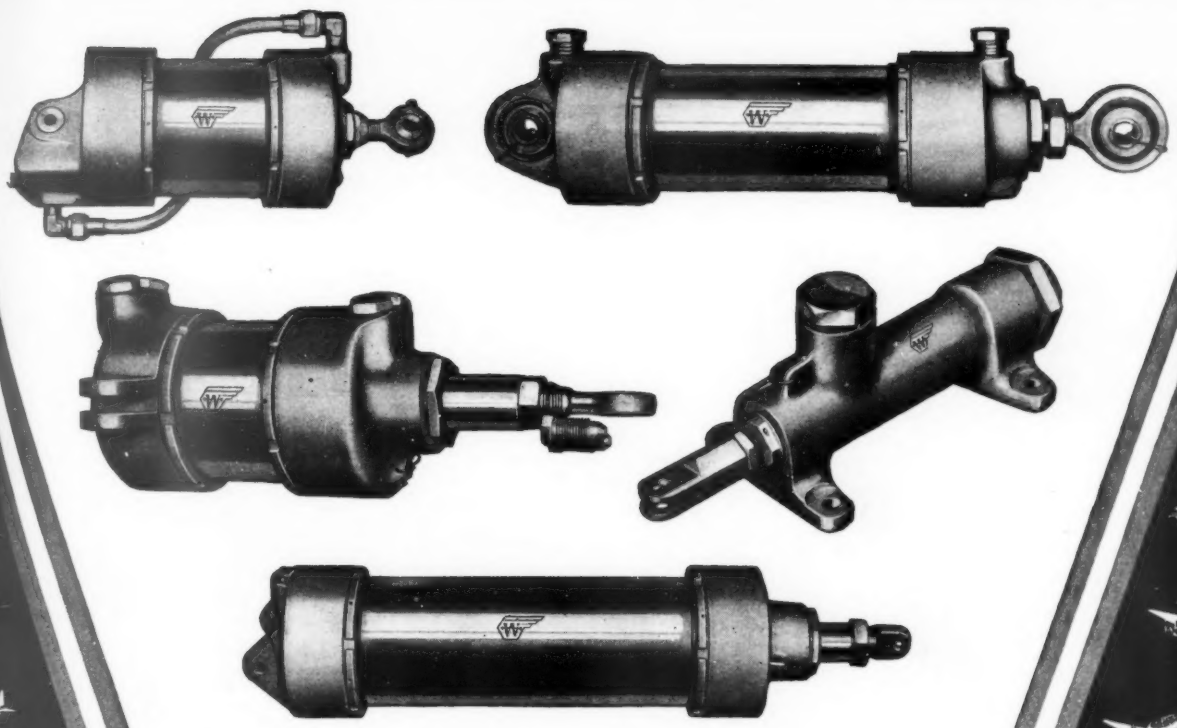
"From test experience with other bearings which were damaged in a manner very similar to the damage incurred by these bearings," the CAB report of the accident said, "it is estimated that the duration of the over-revving was from five to eight seconds and furthermore, it appears that rotation of the engines was stopped very shortly after the over-revving occurred because certain marks on the crankpins which were caused by overspeeding would have been erased if the engines had again been operated at normal speed."

Those are just a few examples of the thoroughness with which these men perform their jobs.

"Like all detectives," said a CAB official, "we try to arrive at a conclusion by going through a process of elimination. By eliminating all possibilities, we finally arrive at the one probability. We have trained ourselves and our men to keep an open mind before forming a conclusion. And when we finally decide on the answer to the main question —'why?'—we feel as reasonably certain as it is possible to feel that we've hit the problem right on the nose."

END

"Villamore, what the hell are you using for a hose?"



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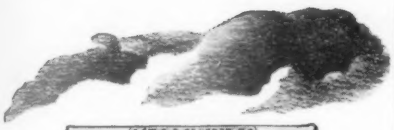

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Navigating Professor

(Continued from page 59)

material is gleaned from other writers since he believes that every student should have access to proved aeronautical knowledge. However, he is meticulous about giving credit where credit is due. In compiling his work on "Instrument Flying" in collaboration with Lieut. Comm. P. V. H. Weems, Zweng insisted on buying the rights to a previous work by Howard Cyrus Stark which contained many pioneer discoveries. Zweng's own work is dedicated to Stark who gave his life when forced down by a storm in the Rocky Mountains while on a flight designed to advance the art of instrument flying.

His books are so much in demand by the Army Air Forces, the CAAWTS, and public and private schools and colleges that Zweng has long entertained visions of a peaceful life in retirement as a successful author. The only catch in the plan is that he is also a successful teacher —one of the best. He holds every rating that the Government gives for aeronautical knowledge, and he knows how to impart his learning to others.

With his slightly gray hair and mild manner, one would never think of Zweng as an accomplished pilot. He does little actual flying nowadays, but he learned to fly with Varney School of Flight in Peoria, Ill., shortly after his graduation from Illinois Wesleyan University. At the same time he was indulging his love for intensive study by taking a technical course at Bradley Polytechnic Institute. Here he learned about aerodynamics and power plants and got his first introduction to the subjects of meteorology and navigation. Deciding to find out more about it he enrolled in a special celestial navigation course at the U. S. Naval Academy, which he completed in 1938. Lieut. Comm. Weems was one of his instructors and a friendship was formed that has contributed much to the science of air navigation. Weems methods went into planning the curriculum for Zweng's school and the two of them have collaborated on books and on navigational inventions which are universally used.

Zweng moved to Glendale, Calif., in 1938, and became instructor of instrument flying for Grand Central Flying School. His contributions to the art were recognized when he became a member of the Institute of Aeronautical Sciences. During this period he put his navigational training to use by plotting courses for Bendix racers who were heading for Cleveland. His proteges always flew very efficient courses but, according to Charlie, they could all have used faster airplanes. He never navigated a winner.

Before the war he was in constant demand as a private tutor in flight subjects and navigation. With the beginning of the Government's expanded training program he was called upon to plan a curriculum for Curtiss-Wright Technical Institute in connection with the establishment of the first Air Corps Training Detachment on the west coast. To see how his course of study worked out in practice he personally instructed the first class of Army cadets at Grand Central Air Terminal in Glendale, Calif.

Now he is back teaching celestial air navigation. Get him started on this subject and you'll see why he puts off retiring on his royalties. This business of getting airplanes from here to there on course and on time with only the sun, moon and stars as a guide is the world's greatest profession, according to Charlie Zweng.

As he talks you begin to catch his enthusiasm. You begin to wonder how all those bombers are going to get to Britain and Australia and India unless you learn how to handle a sextant and fit yourself to plot a course. You agree with him that after this war there'll be huge freighters flying the oceans and airlines serving every town that can possibly produce a passenger or pay the postage on a package. You listen as he howls about the fact that air express is as costly as first class mail in this country while Pan American is carrying packages at freight rates to South America. You become sure that rates must be lowered and you enthuse about the glowing pictures he paints of the future of air transport. Charlie is a great salesman for all of aviation, but he always gets back to the same subject, "What a wonderful opportunity there is today for any young man who'll learn celestial air navigation."

He's sold a lot of young men on that idea already, and he's proved his point about the opportunity. He doesn't guarantee his graduates jobs, but he doesn't have to. Scouts from the greatest airlines and the ferrying commands pay regular visits to the Pan-American College of Celestial Air Navigation. They've been known to hustle particularly promising undergraduates right out from under their diploma and let them finish their training while earning a nice fat salary and getting a lot of flying experience. They go through a short transitional training period, during which their expenses are paid, and then become full-fledged navigators at an average salary of $600 per month with a bonus for each trip.

His institution of higher learning, just outside the boundary of Metropolitan Airport in Van Nuys, Calif., boasts some very distinguished students and graduates. John Conte, singing master of ceremonies on radio's "Coffee Time" program, is at present struggling with sextant and star curves. Lieut. James Stewart (formerly of the motion picture business, but now in the United States Army Air Forces) learned his navigation with Charles Zweng when he was only a Sunday afternoon private pilot. Bob Perlick was one of the Bendix racers Zweng plotted courses for, and later took a course in navigation at the school.

Now Bob is a captain in the Royal Air Force Ferry Command and, according to a recent letter, has just completed his 14th trip to England. That means 14 more bombers for Britain chalked up to the credit of the navigation school which Charlie Zweng calls his contribution to winning the war.

One alumnus of the school is now teaching advanced navigation for TWA. Several others are working for Pan American Air Ferries, Inc. More are with America's armed forces and the many with airlines in all parts of the world.

Pan-American College is a private institution but it has the backing of both private and Governmental aviation. TWA started the ball rolling immediately after the attack on Pearl Harbor by requesting more navigators. The Zweng school was the only school equipped to answer the call and overnight it boomed into a navigator factory. From a one room, 10 students affair it spread out to where 65 students is now the average enrollment. Zweng had to have help and started building a faculty which now numbers five top-notch instructors headed by Robert Cochrane Mack, U. S. Naval Academy graduate. Charlie spends most of his time keeping the course of study up with the late developments which come out of the war. The other airlines have learned to look to the school for good men, and the chief of the Army Air Forces has co-operated by making available restricted manuals on celestial air navigation published by our own and the Allied air services.

The school teaches the latest methods and uses the finest equipment available. The new Link bubble-type octants with averaging device, which are standard equipment for the U. S. Army Air Forces are available to students without charge. With these instruments amazing speed and accuracy are possible in plotting position, even under the adverse conditions usually found in flight. Second setting watches, set to Greenwich Civil Time, are also supplied. The students likewise enjoy special chart boards and other navigation aids invented by Zweng, which make for ease in rapidly computing position.

The course of study covers 125 hours of actual instruction and the practical use of all types of celestial navigation equipment. Subjects covered include sun and moon sight, charting and plotting lines of position, star work and star altitude curves.

The course in celestial navigation is open to men only and applicants are required to have at least a high school education and have completed a course in primary navigation. The latter requirement is frequently taken care of right at the school where regular ground classes are given. It's Zweng's belief that a good aerial navigator should know plenty about all branches of flying if he is to do a good job after graduation. Therefore the ground courses stress pilotage, dead reckoning, instrument flying, meteorology, theory of flight, aircraft engines and related subjects.

Despite its impressive contribution to the war effort in training navigators, Pan-American College is hardly to be ranked physically with America's great collegiate campi. It's a small, white building just across the road from the airport. Military planes supply audible atmosphere as they take off right over the roof. The school is efficient and well equipped, but there still clings to it the delightful atmosphere of the old days in flying before mass production set in. The classes are larger now than ever before, but the students can arrange their schedules around the demands of their regular jobs. They may linger after class if they wish to discuss a particularly difficult problem and they may take as many weeks as they need to complete the course.

This school was the first college of celestial air navigation to be established, but many others are planned to supplement the Government and airline facilities. The future of air navigation now appears to be as big a field as Charlie Zweng has always envisioned. Air authorities agree that freight and express shipments by air on a scale heretofore undreamed of are a certainty after the war. Airline service will undoubtedly be broken down into short feeder lines serving small areas and long lines branching out to all parts of the world. Transoceanic flying, or airline development in terrain where radio aids are difficult to build and maintain, will demand the services of countless celestial navigators. As the navigating officers are the aristocracy of the marine world, so they may well be the top men of the aviation profession.

A new sidelight on the wartime need for navigators is provided by a recent request for training by tank officers. The commander of a west coast armored division recently made arrangements for a few of his officers to undergo training at Pan-American in preparation for desert warfare. Large tanks, operating over barren desert terrain face the same navigational problems as airplanes or ships at sea.

With the spirit of a true teacher, Charlie Zweng keeps close track of his former students who are scattered about the world. Hanging on the bulletin board at the school are letters from these boys, and quotes from a few of them make pungent reading. All of them reveal a tremendous pride in the importance of the navigator on today's large aircraft. As one lad put it, "the hottest pilot in the world is going to have a tough time getting a bomber to Australia without one of us along to tell him where the place is."

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{Below} Checking in Strato-Clipper express and mail... up from South America in less than a day!

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hints which are passed on to the students at the school. One navigator rambled at some length about the virtue of confidence on the part of a navigator. He wound up by writing, "you have to be able to stick your pencil in a cocked hat, walk up to a pilot who's been flying since you were in grammar school and say to him, "we're right here. Not a mile from here or two miles from here, but right here." From all reports, the graduates of the Pan-American course hit their objectives on the nose and *know* they can do it every time.

Charlie Zweng's friends and neighbors appreciate the job he is doing for his country and its allies. Among his friends he numbers some of the highest ranking officers in the Army and Navy. They have the highest regard for his ability and the skill of his graduates.

However, not all of those who come in contact with his school are conversant with the work that is going on there. More than once his students with their sextants have been reported to the Army guards at the airport for taking pictures of military aircraft with secret cameras. Once a suspicious typist, called in to do a mimeograph job, phoned the FBI about a secret code she had been given to copy. Investigation proved it to be sample lesson sheets of star shots and sextant readings, designed for use in the college ground school.

Zweng claims that his biggest thrill was tuning in his car radio one day and hearing the voice of one of his former students by shortwave from London. The professorial heart beat just a little faster when he realized that knowledge gained in his school had enabled this young man to get to England safely with a big bomber and its crew entrusted to his care. He says that when he heard that boy's voice, he decided that he had found the best spot for himself in this war. He'd just go on developing the *best* navigators in the world.

You can't help being sold on a man who's as sold on his job as that, and you can't help feeling that when American aircraft are needed at the front anywhere in the world they'll get there—especially the ones which are navigated by the alumnae of the Pan-American College of Celestial Air Navigation.

Charlie Zweng's name may be on the last page of the telephone directory, but when the story of aerial navigation is written, it should be moved up to page one.

END

Engines and Altitude

(*Continued from page* 32)

not to create detrimental temperatures and use up excess horsepower and at high speed at high altitudes where the need for supercharging increases. The pilot manually changes the speed when he deems it advisable. It may also be automatically changed by aneroid control. This type gives an advantage at take-off and early climb but is heavier and more complex.

By variations in supercharging, the same basic engine can be adapted to use in as many different plane models. A ground attack airplane, for instance, with no altitude performance, becomes the best highest altitude engine when fitted with turbosupercharger and intercoolers.

Some of the other types of superchargers include the two-stage supercharger with mechanical clutch—two separate superchargers with their airflow lines connected in series, one of which is positively connected to the engine and is always in operation, and the other one which can be put into operation by engaging the clutch—and the aforementioned turbosupercharger with intercooling.

The use of intercooling to lower the temperature of the air and air-fuel mixture is necessary because of the heat generated by the greater use of supercharging. A heat exchanger between the first and second stages of supercharging provides the "intercooling" and contributes to "volumetric and thermal efficiency" and permits the use of maximum compression ratios without danger of "detonation" or "knock."

Turbosupercharging is one of the outstanding developments of American aviation and dates back to 1917. Instead of being driven directly by power from the engine's crankshaft, the turbo drives the second-stage supercharger by the exhaust blast of the engine and thus does not subtract from the engine's power.

With the variety of methods of supercharging, a plane designer can fix the "critical altitude"—that altitude at which the plane attains its maximum speed in level flight—about where he desires. Thus, to say that any particular aircraft engine has a critical altitude of, say, 15,000 feet might be grossly inaccurate for, by varying its supercharging, that engine might be given a dozen different critical altitudes ranging anywhere between 1,000 feet and 30,000 feet.

While the different types of supercharging give maximum engine performance all the way from sea level to critical altitude, it should be remembered that the effect on the airplane performance of the additional equipment can more than offset the advantages because of weight or drag.

"It is therefore axiomatic that in planes of carefully balanced design," the paper said, "those planes that perform best at the high altitudes cannot compete in the lower altitudes with those equipped with the simpler lighter supercharging designed for low altitudes, or vice versa.

"For planes designed to operate predominantly in the relatively low altitudes the advantage of the simpler types of supercharging, with less weight and less bulk and fewer pieces to fit into the plane, becomes obvious. This weight and space can be used for guns, armor, ammunition or more gasoline."

The paper pointed out that one of the commonest errors in lay evaluation of American and European planes has been to compare the critical altitudes of the American craft with the "service ceilings" of the lafest European models. Actually that is like comparing apples and pears, because the service ceiling of a plane is the highest altitude at which it is practical to fly that plane. Usually it is defined as the maximum altitude at which the plane still can maintain a rate of climb of 100 feet per minute. The true measure of superiority, therefore, should be the performance of a plane at any altitude, compared to that of the enemy's plane at the *same* altitude.

"Another common misconception is

FLYING

"We built it to compete with Lockheed."

他們來了

"...they have come"

Here's another Northrop technique

now helping to speed U. S. warplanes abroad

BEFORE a warplane reaches the final assembly line, hundreds of small metal parts must be fastened together into wingtips, engine nacelles, tail surfaces and other sub-assemblies.

Many of the small parts in these sub-assemblies are *spot welded* one to the other, and formerly this demanded tedious one-piece-at-a-time cleaning and preparation.

Not so, any longer. Today by a new Northrop-developed technique the whole sub-assembly is fastened together by what are called "skin-tights". The job of cleaning and preparation is all done at once, in a single quick bath.

Then, still held fast together, it all goes in one piece to spot welding machines—and comes out finished.

This new Northrop development is being made available to other U. S. plane builders. So are other techniques by the Northrop group.

In return, other plane manufacturers inform Northrop of their new ways of building warplanes faster, with fewer man-hours.

And this business of trading techniques — of putting aircraft production on an "all-for-one-one-for-all" basis—is one reason that U. S. planes are now striking in such numbers on so many far-flung battle fronts. It's one reason oppressed people in many lands now look upward for deliverance — now are able to say in joy, "THEY HAVE COME!"

NORTHROP AIRCRAFT, Inc.

Northrop Field, Hawthorne, California

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

that the critical altitude is the highest point to which a plane can fly or at which it can effectively fight," the paper went on. "This, of course, is simply not true. A sea level high-horsepower engine will take a plane into the stratosphere if the plane is sufficiently light and has enough wing area. The point is that it will not take it there as fast as will a higher supercharged engine, nor can it operate the plane at as high speeds as can the higher supercharged engine when high altitudes are reached.

"As a matter of fact, the service ceilings of all American fighter planes, supercharged or unsupercharged, are surprisingly high over the critical altitude . . ."

Stressing the importance of the effect of the weight of a plane upon certain features of its performance—particularly take-off, maneuverability and climb—the Allison engineers showed that a fighter plane weighing 5,000 pounds (roughly the weight of a Jap Zero) needs 500 feet in which to take off, whereas a plane of otherwise identical aerodynamics but weighing 8,000 pounds requires 1,275 feet for take-off. Similarly, the 5,000-pound ship can turn in less than half the distance required by the 8,000-pounder at the same speed.

Using a hypothetical bombing attack to illustrate the effect of weight upon a fighter plane's rate of climb, the paper showed that if the 5,000-pound fighter intercepted an enemy bomber, flying at 25,000 feet altitude at a speed of 350 m.p.h., 55 miles from the target city, a 6,000-pound fighter would intercept two minutes later when the bomber was only 43 miles from the city. The 8,000-pound fighter, however, would not make contact with the bomber until nine minutes later, at which time the bomber would be directly over the city and, because of the forward thrust imparted to the bombs by the speed of the plane, would already have released its deadly cargo.

Superficially, the Allison men wrote, it would appear that for the business of protecting a city from bombers the lightest fighting plane would win hands down.

"It can get off the ground much quicker, it can turn much quicker and it can get where it has to go much quicker. But the plane designer with that given amount of horsepower and supercharging to work with must remember something equally vital in protection against bombers:

"What is going to happen when the plane gets there? Is the fighter going to have sufficient armor to enable the pilot to face the bomber's murderous machine gun fire at sufficiently close range to get in effective shots of his own?

"Is he going to have sufficiently large guns to really blast the bomber out of the sky?

"Is he able to carry sufficient ammunition to stay in there and fight until the job is done?

"Can he have leakproof tanks so that a well-directed shot from the bomber will not instantly make his fighter a flaming coffin, or reduce his gas supply to the point that he has to abandon the scrap and get to the ground?

"Can he carry enough gasoline to stay in the fight until he has accomplished his mission and still be able to get back home even though the chase has carried him a long way off?

"Can he have sufficient of the ingenious instrumentation devised by American engineers to enable him in split-second glances to know the things about his engine, plane and guns that supplement his natural and acquired skill in their greatest utilization in a hot fight?

"Is his plane sturdy enough to take some enemy hits, and undergo the strains of dives and sharp turns without falling apart?

"The way they're going now, we'll be obsolete by 1944 . . ."

"It becomes obvious that the lightest plane cannot have much of these advantages. It is equally obvious that the heaviest plane many times will 'get there' too late to prevent the bomber from carrying out its mission. Once more compromise becomes the effective answer. The 7,000-pound plane could carry approximately a ton more equipment and supplies for effective fighting than the 5,000-pound plane and still meet the bomber 25 miles from the city in our theoretical charted attack.

"Maneuverability and climbing ability are important, but they are by no means the whole story of successful air fighting."

In view of the effect of weight upon plane performance, it becomes clear that the plane designer is limited constantly as to the types of supercharging and other auxiliary equipment he may put in a fighter.

"Some of the more complicated types of supercharging equipment are so bulky with relation to the trim outlines of small fighter planes," wrote the Allison men, "that their installation would necessitate changing the shape of the fuselage, bringing up new problems in aerodynamics, and possibly resulting in loss or reduction of the original aerodynamic advantages of the particular plane.

"Sudden changes in the requirements for pursuit performance such as changing the high altitude fighter to a low altitude fighter, or vice versa, require not only airplane modifications but also delicate rebalancing of reduction gear ratio and propeller designs for optimum performance. Tuning the gear ratio and propeller to the particular job of the airplane is imperative. For instance, larger diameter, wider and heavier propeller blades are required for high altitude work than are most suitable for low altitude. These factors are of particular importance with regard to climb and maneuverability."

In summation, the Allison paper pointed out the global warfare involves a wide variety of climatic and tactical situations, as a result of which this country "dares not be without a *complete* line of planes that can meet these varying conditions. It must have the lowfighters for attack (in cooperation with ground troops, etc.) as well as high fighters for defense and they must be able to operate in heat or cold, dust or damp."

In all those planes, it was explained the basic engines *can* be the same, although the complete power plants will vary because of the necessity of varying the auxiliaries, such as superchargers, in order to preserve the greatest possible amount of power up to the altitude at which maximum performance is desired.

"This country has fully developed the basic engines and the auxiliaries necessary to provide this power plant performance at whatever altitude and for whatever duty the Army or Navy specifies," the paper said, "and they are good *the world around.*

"Care must be taken in attempting to evaluate fighter aircraft to insure that the basis of comparison with enemy or allied craft is the same. No fair comparison can be made unless it is of planes designed for the same mission under the same world-wide conditions."

By the same token, it is unsound to compare the latest model planes, which the enemy happens to put into action, with America's last-year's models because of the likelihood that at that very moment, the U.S. may have already in production a plane far superior to the enemy's but which is being kept secret for obvious military reasons.

END

When an Anderson Instructor Says:

"Okay, son, You'll do"—

HE'LL DO!

● The *quality* of our flyers in the long run is largely determined by high standards of instruction. In close cooperation with the Army Air Corps, instructors for Anderson Air Activities are today supplying the bedrock skill on which future careers will be built—fighting airmen of this global war—pilots for the global commerce of tomorrow.

These seasoned, practical flight teachers were selected and built into the Anderson organization for traits of character as well as experience. Their knack of *communicating understanding* is invaluable to the beginner feeling his way toward skill. Cadet pilots under the guidance of these men reflect their qualities of skill, leadership and responsibility.

Every one of my instructors is C.A.A. Licensed. Many hold engineering or teaching degrees. All are essentially keen in determining when the student is ready to take his next important step. All are AIRMEN in the finest sense.

Gilmore Lindsey

ANDERSON *Air Activities*

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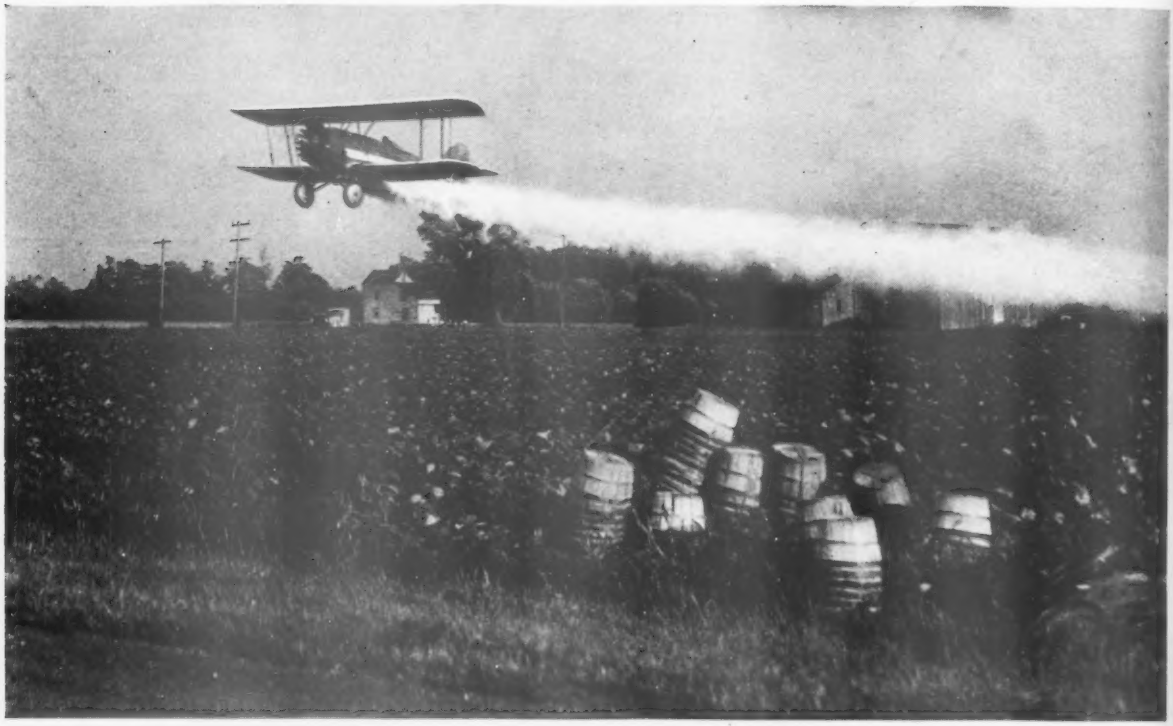

A crop-dusting Waco zooms at the end of a run in preparation for another sweep of the field.

by DONN HALE MUNSON

Airplanes are supplementing the plow in the south where a flying crop duster has now become almost as important to the planter as his seed.

IT'S a better than even bet you never realized that somewhere in Dixie a flyer risked his neck and airplane so you might have the cotton shirt you are wearing, the oranges you had for breakfast or the beans you may eat tonight at supper. But he did—he was a low-flying crop duster, one of those capable hedge-hopping gentlemen who aid farmers in a constant war against destructive insects.

Born of necessity, dusting from aircraft has saved thousands of crops from boll weevils, flea-hoppers, the Army worm and other insects. During recent years big strides have been taken to improve dusting operations, and while that means of fighting bugs had a difficult time in being accepted by farmers throughout the south, it's now an accepted aid—almost as prosaic as the tractor itself.

With the migration of the destructive Mexican boll weevil into Texas and the rich Delta lands there came experiments with dusting to preserve the crops. Dusting was first tried by hand, the farmer spraying it through a nozzle on a hand gun. Next came a saddle gun, operated by a rider on a horse. Then came a mule- or horse-drawn machine which sprayed six or seven rows at a clip. All of these worked to some extent but the demand for speed sent men looking for better means. King Cotton called for hurry-up action.

In the search for speed the Government came to the aid of farmers. The airplane was the answer! At Tallulah, La., in 1922, at a Government experimental station the idea was born. Pilot Johnny Payne was the first pilot on record to go aloft to aid the American farmer. Now stationed at Baton Rouge, La., as a captain in charge of an air training school conducted by the Government, he dusted from 1922 to 1937.

The experiments worked so successfully that cotton dusting today is as necessary to the large-scale southern farmer as are the seeds themselves. Today commercial pilots check the spread of boll weevils and other harmful insects almost before the pests can get started in life. The speed for operation is explained in the fact the boll weevil punctures from seven to 14 squares of cotton every 24 hours and deposits eggs which hatch and reach their maturity in from 16 to 18 days.

Now, how does a farmer determine whether he needs his fields dusted? He leaves it to an expert, a scientific bug-catcher called an entomologist. Each dusting company usually employs its own. The entomologist picks 20 squares of cotton from each corner and a like number from the center of a field and makes what is known as an infestation analysis. If his findings show the cotton he picked is infested to an extent of 20 weevils, the duster enters the picture.

Under normal conditions with infestation below forty per cent, only one application is needed. For Army worms, more dust is needed. Usually each field is given three applications—just to make sure. The dust is dropped three days apart, weather permitting.

Let's get flying. After a commercial dusting outfit, such as Delta Air Lines (which also operates a commercial airline service, but which is almost as

(*Continued on page* 98)

Curtiss

AUTOMATIC SYNCHRONIZER

Simplified Four Engine Control Through Automatic Propeller Synchronization

CURTISS
ELECTRIC PROPELLERS

HEY'RE GRASSHOPPERS—B'GAWD!

Abel Grasshopper . . . reporting for duty, sir! Able to climb quickly from restricted space . . . . . able to land anywhere—ready and willing to do any tough chore the Army may assign.

War or Peace . . . when anything new takes place in lightplane progress, expect it to start with Aeronca . . . that's why Grasshoppers were born! ☆ ☆ ☆ Just a short time before America's official entry into the war, the Army decided to experiment with light planes under actual combat conditions . . . take-offs from small, bumpy fields . . . landings in congested areas . . . sometimes a country road . . . often just a common cow pasture . . . all kinds of weather . . . and constant alerts both day and night. ☆ ☆ ☆ And the easily handled Aeroncas came through all gruelling tests with such a record for dependability, that today, satisfied Air Corps Personnel allocate them for pre-glider training, liaison work with troops afield, artillery operations, and various other assignments for which their maneuverability and control qualify them. ☆ ☆ ☆ Officially designated as the Army's L-3-C . . . a keen-minded brass hat, after seeing them perform, promptly dubbed them "Grasshoppers" . . . We emphasize with modest pride this apt appreciation of Aeronca "First and Finest." Aeronca Aircraft Corporation, Middletown, O.

A full-color book to delight the young in heart . . . Walt Disney's "Mr. Grasshopper Wins His Wings". Send 10¢ in stamps to Dept. E, Aeronca Aircraft Corp., Middletown, Ohio.

AERONCA

FIRST *Grasshopper* FINEST

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SERVICE FOR TOMORROW

by
EDWARD
CHURCHILL

Webb duVon isn't waiting for the post-war boom in flying. He is preparing now for the airman who is tomorrow's sportsman.

Here is an Interstate "Cadet" being serviced, but Beacon Field could service B-24's.

L. Webb duVon

TODAY, even with civilian flying handicapped by wartime regulations, there is a need for aircraft service. On a figurative tomorrow, when hostilities have ceased, it is generally expected that civil aviation will come into its own. If, as predicted, the skies are filled with thousands of ex-war flyers and the coming generation, service to them is to be the keystone. There can't be growth without it.

One school of thought today says, "We'll go on as we are, a bit haphazardly. We'll wait and see if the boom comes. Then, when we start getting business, we'll expand to take care of it."

The other says:

"Now's the time, fellows. Let's go. Let's take the money we are making under the War Training Service, use it to improve our fields, our hangars, our shops and our facilities. Let's show the prospective private pilot that we've got what he needs to keep him flying and he'll get a plane."

Today, there are many cities of 100,000 population and more which do not have decent facilities of any kind. In some cases the mechanical means of giving service just aren't there. In others, the operators have become so involved in WTS programs that itinerant private pilots are treated as annoyances and private owners basing at these airports are allowed virtually to shift for themselves.

What could be done about it? Let's go to LeMars, Ia., a city of 5,000 population, seat of Western Union College, with 505 students. Beacon Airways, operating here, has a War Training Service unit on its trim field a mile and a half from the center of the small community. Western Union College owns the field, with its three runways, 3,100 feet, 2,540 feet and 2,480 feet long, the two hangars and the small operations building. Beacon Airways owns the 26 airplanes, ranging from Interstate *Cadet* trainers, Porterfields and Waco UPF-7's to a Waco YQC-6 custom.

The total investment is said to be a little bit greater than $50,000. Recently Beacon Airways branched out to Sheldon, Ia., which is even smaller than LeMars. Two instructors, operating hangared monoplanes, teach students of the WTS from Sheldon Junior College.

Beacon Airways, approved repair station for several months was unique in that it was the only one within hundreds of miles. A short time ago Des Moines got Government approval, which brings the nearest approved repair station to within a radius of 200 miles.

L. Webb duVon, president and chief flight instructor of Beacon Airways, says:

"With our two A and E mechanics, three helpers and facilities we could completely overhaul the motors of a B-24 if it landed here — provided we were serviced with parts. As soon as we get the power rivet gun we ordered we'll be able to make repairs on all metal aircraft of any kind. As it is we are thoroughly equipped to repair any fixable damage to any wood, cloth and metal tubing aircraft.

"As far as engine maintenance is concerned, if in the next hour three Continental, three Franklin and three Lycoming motor owners landed for major overhauls, we would have the facilities, help and parts to take care of all of them."

Webb duVon, a plumpish, genial guy, gets a kick out of helping anybody in trouble. The odds are 10 to one that if a visiting pilot has nothing to do that evening he'll be asked up to the duVon homes—Webb and his wife live in one and Webb's brother, Kenneth (whom he taught to fly in 1941) and his wife, live next door—for a bit of refreshment. For friends, there are extra beds.

Under an arrangement with a Sioux City automobile dealer who has become financially interested in Webb's project, two cars were always made available for students—a difficult problem for the airport men to solve with nation-wide gas rationing now in effect. Not only were the cars available to the students, but visiting pilots were asked if they wanted to be driven anyplace special. If the pilot had any errands to run a car was placed at his disposal. There was never any charge made for this service which operated even during the tire shortage crisis.

Another thing—the prevailing price of gasoline in this section has been 28 cents per gallon. DuVon's service men pumped it into pilots' tanks for 25 cents a gallon.

"At the lower figure there's seven cents a gallon profit. That's enough to make," duVon says. "We pay only two cents a gallon more than a filling station proprietor—so why charge any more?"

DuVon is grateful for the WTS. He's doing a good job with the students he recruits from Western Union College. But he doesn't feel dependent on the WTS.

He explains:

"If the war stopped tomorrow and restrictions on private flying were lifted, we could sell enough lightplanes right here on this field to keep us going for at least two years. Those who have learned to fly with us are 'sold' on being plane owners, and they would be."

In the face of current restrictions, he has had two prospective owners sign for new planes and five more have signified their willingness to purchase. The present field was opened in April, 1941, and since that time duVon has sold ships to 11 customers. On the whole, they've been more than pleased.

"One of the things which will come with post-war sales will be service guarantees with aircraft which will provide for service and replacements up to at least four months of service or 200 hours of service," he asserts.

The reason that a qualifying clause is put into this article in regard to the satisfaction of the duVon customers is because of one owner who has become famous in that section of Iowa. The proud new owner had a penchant for landing the ship anyway, anywhere and in any wind. Inside of a short period of operation, he had gone through fences, wrecked undercarriages and had otherwise damaged the plane. Each time he cracked up, no matter where he was, he'd call duVon.

"Get down here in a hurry," he'd say, "and get me out of this."

DuVon's profit from the sale of the plane, which never once had failed in flight, was under $200. When he found that flying time, trucking service and incidental expenses in bringing the plane back to LeMars ran to better than $300 he surrendered for the first and only time in his life.

"There's a limit to service," he says.

DuVon's mechanics — Don Tillotson, a Charlevoix, Mich., lad who has been with him since the new field opened, and Ed Canaday, formerly with Mid-Continent Airlines—explode any remaining belief that maintaining aircraft is either a mysterious or complicated job. Canaday, a flyer and plane owner himself, gave up his job with the airline because, he says, "You can't learn anything just putting gas into tanks."

"Today's cost, and the post-war cost of a 100-hour check should be from $4.50 to $6," Tillotson says. "The ships we're getting today are getting better and better and less and less complicated. You used to swear yourself blue and spend hours putting in windshields, for instance. Today, on one model, the job can be done in half an hour due to simplification.

"There is a tendency to design mounts so that accessories are much more easily reached. You don't break your wrists trying to get magneto covers off and you don't bump your head trying to get a look inside them. Bushings on control surface hinges give you 500 hours without noticeable wear, where before you had to watch them and wear showed in 100 hours.

"In the shops themselves portable hoists, movable tool stands and other labor-saving devices will speed up maintenance and repairs and make flying much more economical than it is even today."

Tillotson and Canaday both have discovered that maintenance is best accomplished by knowing each plane and, at the same time, by watching the wear on certain parts which have 'gone out' on similar models.

"If you know what you are going to have to do and have the parts ready to do it, it's a lot easier than to have the part fail first and then make repairs," Tillotson says.

Tillotson believes that the greatest single improvement in recent months is the simplification of the undercarriage with adequate provision for its lubrication.

"The lightplane we have today is so simply built that there is seldom anything to be done to it between checks," he declares. "The lightplane of the future, with ball bearing controls and other inexpensive but practical features, will be maintained mainly as an automobile is, with a printed sheet directing the mechanic to the various points which need to be oiled, inspected or replaced at certain definite periods."

DuVon, backed up by a mechanical staff which makes good on his promises —if your ship is to be checked, gassed and ready to go it is on the line at 10, probably with the motor warmed for you —started out in 1940 to prove an idea which he stumbled onto. This idea was that in small towns there were scores of druggists, dentists, lawyers, truck drivers and even housewives who would fly if flying was brought to them. He got a partner, William Eirinberg, of Sioux City —now in the armed forces—and explained his idea.

"We'll open up in Sioux City with a couple of airplanes, but we won't bother with teaching anybody there," duVon explained. "We'll start a regular service in 14 small adjoining towns. That's seven towns per week for each airplane. For instance, on Monday we'll fly to LeMars, operating one plane there for the entire day. We'll advertise in the local papers, enlist civic bodies and so on. We'll have regular field appointments."

In other words, duVon had taken a page from the book of the barnstormer but, instead of selling rides, he was actually training his clientele. The business grew and began to prosper. Then came the chance to settle in LeMars, teamed with Western Union College. DuVon went into a temporary field with an inadequate hangar. The field was donated by an air-minded farmer for the winter with the understanding that duVon and his airplane would have to get off when the spring plowing began. DuVon was a little late moving to the present field and the farmer very blithely plowed around the plane. Getting it out was quite a task.

DuVon was born in Rock Island, Ill., on August 8, 1911. After leaving high school he spent two years at the then Porterfield University of Aeronautics. He was 17 when he first learned to fly, now has about 3,000 hours. The reason that he hasn't more is that after a couple of years with the Saunders-Fly-It-Yourself System at Kansas City—the firm eventually went out of business—he ventured into tobacco.

During a part of this time, he owned a Davis monoplane, but had to give it up due to finances.

Eirinberg was also in the tobacco business.

"Travelling around the country by plane showed me that there was really no such thing as aircraft service in cities of medium size, and talking with hundreds of people convinced me that it was possible to find business provided that you offered real service."

DuVon is ready today to face the post-war period. He is using seven instructors, including his brother, Kenneth, at

(*Continued on page* 136)

The airport serving Western Union College is a modest field, but DuVon has made it one of the busiest in that area. The original field at LeMars was a farmer's pasture.

Even on runways hacked out of the jungle

AEROL landings are always safe!

In today's global warfare, Aerol landing gear is serving on such diverse terrain as the steppes of Russia, the scorching sands of North Africa and emergency fields roughly hewn in the wilderness of the South Sea Islands.

In every case Aerols are performing superbly, insuring safe, smooth landings and take-offs that protect the plane and crew.

The splendid performance records now being established by Aerols on world-wide battle fronts are but a continuation of their earlier, peacetime accomplishments. Their success also offers sound evidence that Aerols will do an equally outstanding job in the almost limitless future of after-the-war aviation.

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AEROLS*

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VICTORY IS EVERYBODY'S BUSINESS

This is not just a man's war—winning it is everybody's business. Men and women workers are sharing equally in the responsibility and the credit for the results accomplished in America's war production program.

At Solar Aircraft this sharing of the production burden has contributed much. It has, in a large measure, made it possible for Solar to produce unprecedented numbers of "anti-monoxide" exhaust manifolds for America's fighting airplanes.

ARMY E NAVY

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EXHAUST SYSTEMS—

SOLAR AIRCRAFT COMPANY ★ SAN DIEGO, CALIFORNIA

Industrial Aviation SECTION

AUTO BODY STEEL IN AIRCRAFT

Peter Altman, Vultee's manufacturing research head, inspects sample panels.

The "Valiant" was the first plane to utilize the new Vultee composite sheet. This metal adapts to aircraft the same type of commonplace steel used in auto bodies.

A DEVELOPMENT that makes it possible to build airplanes with the same type of commonplace steel used in automobile bodies promises to revolutionize important elements of aircraft building before the war is over.

The new development was recently announced by Vultee Aircraft after several years of extensive research. It makes available a non-critical, lower-cost material to replace sheets of aluminum for which no practical substitute in the mass production of sizable aircraft has heretofore been found.

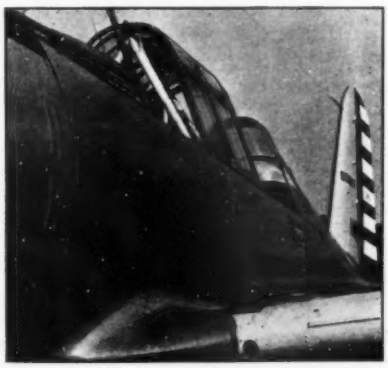
The change-over from aluminum to steel will be accomplished at the Vultee plant in southern California. The new material will be used first in fuselage side panels, cowlings and fuselage sections, and the present plan is to extend its use to entire ships, section by section, as fast as the details of conversion can be worked out and the steel mills can be equipped to supply panels of the new material. The change-over is being made with the complete approval of the Army Air Forces.

The panels consist of a skin of standard auto body sheet steel backed up by a mesh of expanded metal. The two are spot-welded together. The sheet metal mesh is the standard type such as is used as lath in stucco work, as guard fencing around moving parts of machinery and as tray holders in refrigerators. It is made by simply slitting a strip of steel and pulling it open, or to use the technical expression, expanding it.

In the fuselage units now being made, the skin is of very thin gauge—only .008 inch. Yet the welded panel material has a strength and stiffness as great as the aluminum sheeting it replaces, and is as light.

The idea of using automobile type steel in aircraft has intrigued designers for a number of years: (1) its basic cost is lower than aluminum, (2) its tensile strength can be carried over a wide range and made as high as three times that of aluminum, (3) the country has a tremendous productive capacity for this type of steel, (4) it provides all the advantages of metal protection against fire hazard, (5) it can easily be spot-welded (despite recent advances, aluminum spot-welding is still very difficult and the equipment is four to five times as expensive as even the best equipment for welding steel) and (6) methods of processing and fabricating low-carbon steel are well known and production techniques in this field are highly developed.

Side panel installation of the composite expanded steel on Vultee basic trainer.



With the country at war and the nation's entire economic and industrial structure thrown out of kilter, at least two other very important factors have made the use of automobile type steel in aircraft more desirable than ever: (1) it would release thousands of tons of critical aluminum, yet itself would require none of the critical elements common in steel alloys such as nickel or chromium, and (2) it would provide some use for the almost unlimited press capacity for processing sheet steel which has been made idle by the war in hundreds of plants that normally manufacture automobile bodies, desks, cabinets, refrigerators and other such pressed steel products.

Despite all the advantages, the use of low-carbon steel sheets as a direct substitute for aluminum remained impracticable until just recently. For one thing, the weight of steel is 2.8 times that of aluminum. Any direct substitution of steel for aluminum would, therefore, increase the total weight of a plane beyond any reasonable limits.

Because of the almost three-to-one advantage in tensile strength, a thinner sheet of steel could be used, its thickness being determined on an equal weight basis with aluminum. The commonly

used .035 inch aluminum sheet, for example, could be replaced with a .0125 inch steel sheet without an increase in weight. But this thin sheet, having low transverse strength and a low compressive rigidity, would buckle easily and have little resistance to local failure.

The problem of utilizing automobile type steel in aircraft was, therefore, clearly one of increasing the effective thickness of the thin sheet without any substantial increase in weight.

The Vultee manufacturing research department went to work on the problem in co-operation with Vultee production engineers. In the early stages of the program, the U. S. Gypsum Company, the Republic Steel Corporation and the Carnegie-Illinois Steel Company supplied various materials.

The obvious idea of combining the steel with another, light material was tried. Plywood and certain plastics, for example, were bonded to the metal. But because of the difference in elasticities and co-efficients of expansion and because of a number of other difficulties that develop in dealing with two dissimilar metals, this attempt was not successful.

The Vultee solution to the problem—expanded metal mesh spot-welded to the thin sheet—provides a homogeneous steel material as light as aluminum and with equal or greater strength and stiffness.

In experimenting with various methods of reinforcing the sheet, the Vultee research department tried perforated metal, wire mesh, a number of different types of stringer reinforcements and many other forms of steel backing. Expanded metal mesh was selected for several reasons. It is easily handled and easily applied. In the process of expansion it is cold worked and thus becomes considerably stronger than the same steel in other forms. And as a composite sheet it is easily shaped and fabricated.

As the power and speed of aircraft is increased, one of the factors that must be given increasingly important consideration in selecting materials is fatigue life. Any material used under stress must have a high resistance to vibration. Steel has a naturally high fatigue limit, and experimental tests on expanded metal sheets show no failures after as many as 30,000,000 reversal cycles. Tests on fuselages and other complete structural sections made of the new material show no failures under several times the normal loads of these units. In addition, long service tests on actual aircraft have substantiated the laboratory tests.

Present plan is to fabricate fuselages and other sections complete at the mills where the backed-up sheets are manufactured. On arrival at the Vultee plant these units will then be ready to be welded into the final structure. No difficult fabricating problem dictates this procedure. The panels can be cut to size on conventional equipment and formed to shape by conventional means. But the panels are to be supplied to the plane plant as prefabricated units rather than as mill sheets in order to help in decentralizing general manufacturing operations as far as possible.

Fabrication of the units is simple. Stringers are welded to the panels at their flanges, and the separate panels and the stringers that join them are easily handled in production, the techniques of welding low alloy steels having been well developed over the years.

One of the problems in using auto steels in aircraft is that of providing adequate protection against corrosion. No rusting can be tolerated. Corrosion protection, therefore, must go considerably farther than it does in the case of automobile body fabrication.

Vultee research in this direction has been given considerable attention. The sheets are electro-galvanized and then bonderized for painting. Tests show that even deeply scratched samples treated this way easily withstand 500 hours of salt spraying without rusting. One of the advantages of this treatment is that the panels can be welded without harm to the rust-resisting finish.

The use of expanded metal sheeting lends itself to a host of far-reaching adaptations which may radically alter aircraft design. Many of these adaptations are already being investigated and developed. For example, the mesh can be corrugated to provide an easy means of fixing other materials to the reverse side of the panel. The inside of a cabin where a smooth surface on the outside and an upholstered finish on the inside is desired would be a typical case in point. The upholstery could very easily be attached to the same metal used for reinforcing the panels.

In the same way, the mesh can be corrugated to form a sandwich-like structure with sheet steel on both sides of the corrugations. This could be used to great advantage in bomb bay doors, for example.

The possibilities of the new material seem at the present almost unlimited. Sound-proofing materials can easily be applied to it. So too can asbestos for fire-proofing. The use of stainless steel would be another adaptation. Or, the basic principal of backing up a metal sheet with expanded mesh could be used with other metals—aluminum, for example. There are applications in the use of other metals such as aluminum where the great weight-saving and increased stiffness effected by this design would be very desirable.

The aircraft industry today stands on the threshold of a number of important developments which will have far-reaching effects both in winning the war and in the post-war period. Certainly the new expanded-sheet design is not the least important of these great developments. This design is turning to reality one of the aircraft industry's most intriguing dreams — the building of airplanes made of inexpensive auto-body steels.

ACCIDENT TOLL CUT

DESPITE the fact that thousands of new and unskilled employees are being added to its payrolls month after month, the American aircraft manufacturing industry has effected a spectacular decrease in the accident frequency rate during the past year.

This is disclosed in a survey conducted by the Aeronautical Chamber of Commerce of America which indicates that, over all, the odds against an aircraft plant employee having an accident on the job this week or next are about 300 to 1.

FORM "COMMONWEALTH"

THE name of Rearwin Aircraft & Engines, Inc., Kansas City, Mo., was changed to Commonwealth Aircraft Incorporated, effective January 7. C. H. Dolan, II, is the president and general manager of Commonwealth.

Essential in fusing *today's* aircraft

LITTELFUSES

Tested by Magnetic Vibrator, far in excess of most extreme conditions

Providing for new maximums of shock and vibration, Aircraft Anti-Vibration Littelfuses are subjected to a Magnetic Vibrator at 120 cycles a second. Test is ten times that of any service emergency. It determines the minimum hours fuses will endure. Littelfuses often exceed 100 hours of this test.

ELEMENTS TWISTED AT 90°

One of Littelfuse features for severe vibration resistance. Twisted element shown with "Gooseneck" spring-forming, which takes up contraction and expansion.

LOCKED CAP ASSEMBLY

An important Littelfuse anti-vibration factor: Caps are locked. No cement used. To vibration-prevention it adds saving the caps with markings. Also seals element against climatic conditions.

LITTELFUSE INC.

4793 Ravenswood Ave., Chicago, Ill.

THESE WOMEN, MACHINING PRECISION PARTS ON SOUTH BEND LATHES IN A VITAL WAR PLANT, ARE TYPICAL OF THOUSANDS OF WOMEN WHO ARE DOING THEIR PART TO WIN THE BATTLE OF PRODUCTION.

WITH THEIR HELP *We'll Win*

With eager hearts and nimble fingers, thousands of American women are working shoulder to shoulder with men in vital war industries—replacing those who have left their machines to defend their country. And they are doing a fine job of filling men's shoes, for they know that the battle of production must be won to keep their men at the front supplied with the guns, planes, tanks, bullets, and thousands of other things an army must have to be victorious.

Women learn to operate South Bend Lathes in a surprisingly short time. Not that just any girl can become an expert machinist or toolmaker over night. But on certain classes of work—the kind of work that you would expect a beginner to do—women are highly successful.

Quick to appreciate quality, women like South Bend Lathes. They like the fully enclosed design—the smooth operation of conveniently placed controls and the dependable precision that enables them to turn out maximum production. And, most of all, they appreciate the ease of operation which reduces fatigue to a minimum and seemingly shortens the work-day by hours.

South Bend Engine Lathes and Toolroom Lathes are made in four sizes, 9″ to 16″ swings. South Bend Turret Lathes are available in three sizes. Write for information.

TRAINING HELPS

South Bend training helps—books, sound films, wall charts, and bulletins on the care and operation of a lathe—are available for training new operators. Write for a copy of Bulletin No. 21-C.

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 36 YEARS SOUTH BEND, INDIANA, U. S. A.

ELECTRIC GUN SPEEDS ASSEMBLY

KEY parts of electric ranges and household irons are used in a new electric heating "gun" for exploding rivets in hard-to-reach parts of planes. The new tool, manufactured by Westinghouse's electric appliance division, is shaped like a submachine gun and shoots heat into a special DuPont rivet containing in the shank end a small explosive charge about the size of a pin point. The heat sets off the charge within two to six seconds, and the force of the explosion expands the shank to a barrel-shaped closing head which securely fastens the two metal parts of a ticklish assembly or repair job that once had to be done by hammer blows.

Principal parts of the "gun" are modifications of the Westinghouse's peacetime electric range surface heating unit and the thermostat which regulates the temperature of electric irons. The heater is imbedded in the cast iron barrel with the wire element sealed in a tube-shaped metal jacket. The thermostat is installed in the cord circuit. Just as a housewife makes a temperature selection on her hand iron, depending on the type of fabric to be ironed, the operator of the riveting gun selects the temperature needed, depending on the size of the rivet to be exploded. By means of this thermostat the firing time can be automatically controlled to gain the full explosive force.

Household utilities in their wartime guise.

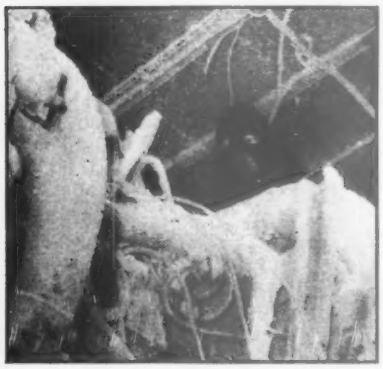
Accurate heat control enables the operator to utilize the maximum strength of the rivet. The handy riveting iron is being used in air service fields on farflung battle fronts and doing a job that cannot be accomplished with conventional riveting methods.

CONDUCT SUB-ZERO ENGINE TESTS

ENGINEERS of Wright Aeronautical Corporation of Paterson, N. J., in collaboration with research workers of the Standard Oil Company, have created a polar climate in a New Jersey test cell to duplicate the sub-zero weather conditions encountered in arctic regions.

Beginning at zero on the Fahrenheit scale and then chilling the test cell 5° lower with each successive test, Wright engineers are using a 1,700 h.p. *Cyclone* of the type which powers many warplanes, to test new fuels, lubricants, batteries, magnetos, spark plugs and other equipment designed especially for cold weather.

Test engineer records the effect of icing.



All tests are concentrated on the five main problems of winter operation. First, the engine must turn over. Pistons, gears, crankshafts and all moving parts must be freed from the vise-like grip of congealed oil. There are two ways to do this: one is to find suitable low viscosity lubricants —oils which flow at low temperatures— and the other is pre-heating in a tent, shed or hangar. With low viscosity oils, the problem also arises of maintaining a protective film of oil on all moving parts at higher operating temperatures, at take-off or in flight.

The second problem is one of turning over the starter. Again, winter lubricants are essential. Battery problems develop, too, for the output of a battery is directly proportional to the temperature; a 24-volt battery in ordinary temperatures puts out only four or five volts at 20° below.

With starter and engine in motion, the third problem is to get fuel to the engine. At 50° below zero, an ordinary fuel will only condense on the walls of intake passages, without supplying the combustion chamber with vaporized fuel for ignition.

With vaporized fuel, a hot spark must be provided. This fourth problem calls for magnetos designed for cold weather output, equipped with cold weather lubricants.

Fifth and finally, the engine has to be designed so that clearances at 50° below zero do not cause interference.

ASK WORKERS' OPINIONS

CESSNA AIRCRAFT COMPANY employees were recently given an opportunity to express their reaction to company policies, personalities and practices. Under the veil of complete anonymity, each employee was given a chance to air any grievances he might have against his bosses, procedures followed in his department and his working conditions.

A questionnaire containing 55 inquiries and space for comment on items not included in the questions was mailed to each employee at his home. He was not required to fill out the questionnaire but was encouraged to do so as a favor to the company. He was specifically requested not to sign his name to the questionnaire nor give his clock number. Only his department number was asked so that any suggestions or comments he might make could be considered intelligently with regard to the specific department.

Questions were asked regarding care of tools and equipment, work planning, instruction given on new methods and general working conditions. Each employee was asked for an evaluation of his immediate superior, on the particular job to which he is assigned and on any dissatisfaction he might have. He also was asked his opinion of the company's credit union, group insurance program and the Cessna Employees' Club.

STITCH FLARE HOUSINGS

Machine "sews" fins on parachute flares.

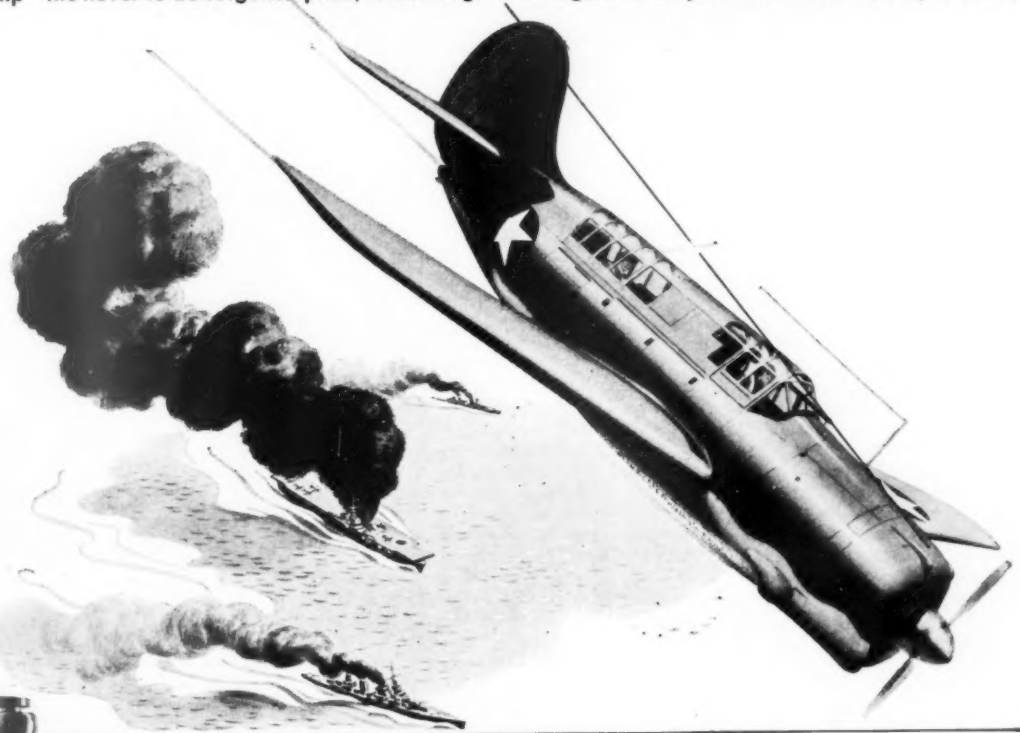
HOUSINGS for giant parachute flares now have their fins "stitched" on by rows of spot welds, made possible by the development of a standard Progressive pedestal welder equipped with two guns —upper and lower—instead of the customary single gun. The center electrode is fixed and serves as a mandrel for guiding the housing. The locating fixture for keeping the fins correctly aligned were removed to show the guns, etc.

About 18 welds are required for each pair of fins welded simultaneously, or a total of 36 welds for each housing.

C26S—Shielded

CHAMPION SPARK PLUGS

are the dependable source of full, flowing engine performance, so vital to a Navy pilot at that crucial moment when an enemy ship—the never-to-be-forgotten prize, looms large in his sights. Champions are on active duty on every front.



C26—Unshielded

Reports are continuously flowing into our offices citing service records of the outstanding performance, long life and extreme dependability of Champion Aircraft Spark Plugs, in engines of every type and size.

These case histories are gratifying to us and the results directly traceable to inherent qualities in materials and design which are the results of truly exhaustive research and engineering over a long period.

Champion manufactures spark plugs, and spark plugs only, and has always backed its products with exclusive facilities and personnel, without equal in the spark plug industry. We believe that is why Champion Spark Plugs are synonymous with dependability, throughout the world.

Characteristic Advantages of Champion Ceramic Insulation Are—

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "shorts".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.

Initiative as well as aptitude of new employees is determined by Lycoming plant's questionnaire. Answers may require study, in which foreman's aid (as above) is given.

JOB QUESTIONNAIRE

HOW much should a new machine tool operator know about his work after he is on the job a few weeks?

And how can a company determine if a new man meets the minimum standard for efficient production?

In normal times these questions just aren't a problem. A good foreman can pretty well size up a green hand after spending some little time with him. But in the present expansion period, a foreman isn't able to spend much individual time with all his new men. And there are so many green hands to be considered that it is important that some standard be established for checking up on all of them.

In this connection, a series of written questionnaires for job-testing developed by the personnel department of the Lycoming Division of The Aviation Corporation, Williamsport, Pa., is attracting considerable interest.

Lycoming, manufacturer of radial and horizontally-opposed airplane engines, has almost quadrupled its shop personnel in the last two years, and is still expanding. In breaking in new machine tool operators the company has adopted the widely-used plan of assigning a new hand to the machine of an older, experienced operator under whose supervision the new man gradually takes over. In a few days or a few weeks, the novice, who is usually a graduate of the Williamsport Technical Institute (the local public vocational school) is able to handle the machine entirely on his own and is then generally transferred to the second or third shift.

The company makes sure, however, that before the new man is put in full charge of a machine he satisfactorily answers a written questionnaire about that particular machine. The questionnaire consists of three parts:

(1) A drawing (or, in some cases, several drawings) of the machine with arrows pointing to all the important levers, wheels, buttons, and other controls. The operator must name and explain the use of all these controls, proper space being provided on several sheets of the questionnaire for the answers.

(2) A series of 15 to 30 questions (depending upon the complexity of the machine) about its operation, such as the setting of the cutters, selection of spindle speeds, use of hand adjustments, the handling of chucks and arbors, lubrication, etc.

(3) A series of 14 questions (standard for all operators) on general shop practice. Typical questions here are: What would you do in case of an oil fire? Who should be the first one to know of a mistake made or discovered by you? How often should your gages and micrometers be checked?

The questionnaire is given the new man within a few days after he first goes to work and he is asked to fill it out at home. Some questions can be answered in a single word, others take a paragraph.

Many of the questions are planned to require the operator to use initiative—he must find the department fireman for some answers, look up the machine manufacturer's manual for others, and generally ask his instructor and foreman quite a number of questions.

BOOST ENGINE OUTPUT

TWENTY thousand additional women are being hired by the New Jersey plants of the Wright Aeronautical Corporation to help build *Cyclone* and *Whirlwind* aircraft engines. This large number of women are needed to fill jobs in new plants opened to meet greatly increased production schedules, and also to fill jobs of men leaving for the armed services. They are to be employed as machine tool operators of all kinds, assembly line workers, bench workers, foundry core-makers, engine packers, spare parts packers, inspectors, laboratory technicians, draftsmen, cooks, waitresses, stock clerks and electrical and maintenance worker.

Personnel officials of the Wright company stressed the fact that no previous shop experience is required for the majority of jobs, such as machine tool operators or assemblers, despite the high precision of aircraft engine manufacturing. Applicants must be over 18 years of age and able to pass the health examinations. In order to acquire the training for shop work, women are sent to vocational school for two weeks of study before coming into the Wright plants. In this time the women workers study shop arithmetic, blueprint reading, use of micrometers and gauges and are given intensive instruction on a machine tool which is the same type tool they will operate in one of the Wright shops.

Special equipment minimizes manual labor.

SPRAY ON—PEEL OFF

A NEW waterproof, protective and abrasion-resistant mask for plastic glass bomber noses and windshields simply sprays on . . . and peels off.

The "spraymask," made by Adhere, Inc., of Los Angeles, is easily applied with an ordinary paint spray gun, and afterwards may be peeled off in a sheet. Major aircraft companies who have been experimenting with its use have found it particularly adaptable for spraying formed plastic glass parts (such as bomber noses and gun turrets) for protection until the plane is on the line ready to fly.

PERISCOPE
NOW a tank can see over a hill! Dependable Lycoming-powered Stinson "Sentinel" ships are acting as periscopes for our mechanized units operating in the four corners of the earth. Through blistering heat and tropical storms Lycoming power never falters in the vital role of powering the periscopes of Uncle Sam's "land dreadnaughts."
LYCOMING
AIRCRAFT ENGINES
The Training Plane Engine of Today
... The Private Plane Engine of Tomorrow
★
Lycoming Division, The Aviation Corporation
Williamsport, Penna., U. S. A.
L
414

(*Continued from page 84*)

widely known in the south for its dusting) sells the farmer on the idea of dusting his plantation, planes arrive at the scene of the dusting. Nine times out of 10 there's a flat, cleared field immediately on or adjacent to the farm to be dusted.

The ships, usually Stearmans, Wacos, Travel Airs or the famous Huff-Dalands, usually powered by Wright J-5 engines of 220 h.p. are loaded with the poison (sulphur compounds and mixtures of calcium arsenic) in pre-dawn darkness. The ships weigh about 3,200 pounds fully loaded and cruise at 90 to 100 m.p.h. The front cockpits have been converted into "V" shaped hoppers made of welded aluminum. At their bottoms are the long narrow gate valves which the pilots open to release the dust. That gate valve may mean life or death to more than the weevils. Dick Buswell, an oldtime duster and now serving as an officer with the Army Air Force overseas, explains the reason:

"No iron can be used on this section of the ship because of the danger of setting off a spark by friction. So hard wood or aluminum is used."

At the pilot's side, close to the throttle, is the calibrated lever which controls the gate valve. His hand rides within an inch of it most of the time he is flying.

As soon as the duster can determine the end of the field, almost before the birds are flying, he begins his take-off. The dawn is quiet. No air stirs. This is essential to sowing the dust properly, for wind, naturally, blows it off the intended area.

The heavily-laden ships waddle down the rough fields and usually the pilot goes through an anxious few seconds until he gets his initial altitude. It is almost as much fact as it is legend that a duster flies *around* trees, rather than over them. Now, screaming along in the semi-dark, the pilot prepares to scatter the dust.

Mounted on the wing of his ship is a small wind-driven motor which furnishes power to an agitator in the throat of the hopper. Dick Buswell explains the agitator closely resembles the one in old fashioned flour sieves. Its purpose is to keep the dust loose and fluffy so it falls easily and in a steady flow through the throat of the hopper.

Aiding in the distribution of the dust is a venturi tube mounted directly beneath the hopper. Square, its front and rear openings are 12 inches deep by 28 inches wide. The top, bottom and two sides are concave, making the throat of the tube much smaller than the openings. The blast from the prop and the forward movement of the ship increase the speed of the air stream through the venturi tube. The speed of this stream leaving the throat of the tube has been conservatively estimated at two hundred and sixty miles an hour.

The peculiar shaped tube sets up a swirling, rolling motion of the air stream and as the dust is dropped only four to six feet above the crops, this horizontal cyclone of dust covers the entire exposed surface of the plants and, mister, the dust really scatters! It spreads in a 60-foot path and after settling, the ground looks as though a snow storm had struck Dixie.

Another danger crop dusters encounter, in addition to flying at extremely low altitudes, is that of dust blowing back into the cockpits and blinding the pilots. One pilot was hospitalized for weeks with swollen, inflamed eyes and came close to losing his sight. However, "socks" were placed around control opening some time ago and the trouble is more or less overcome. Even close-fitting goggles don't provide perfect protection.

Settling down over a row, the duster slowly opens the gate valve control. The everpresent threat of fire keeps him from opening the valve abruptly because of the danger of setting off a spark, despite the aluminum. The dust swirls back over the plants. Always done in warm air, because the sulphur oxidizes at 80°, dusting is tough on the pilots. Visibility is practically nil most of the time and keen depth perception is a vital necessity. Charred tree stumps, cotton shacks, trees at the end of fields, telephone and power wires and other obstructions rear up with startling suddenness.

Yet the wear and tear on the ships themselves is not extreme, pilots will tell you. When you see a pilot roaring close to the ground, pull up in a dangerously steep climb and flop his ship around, you are watching a poor duster. A good pilot handles his ship with caution, making his turns smooth and his climbs accurately steep, but not close to the deadly stalling point.

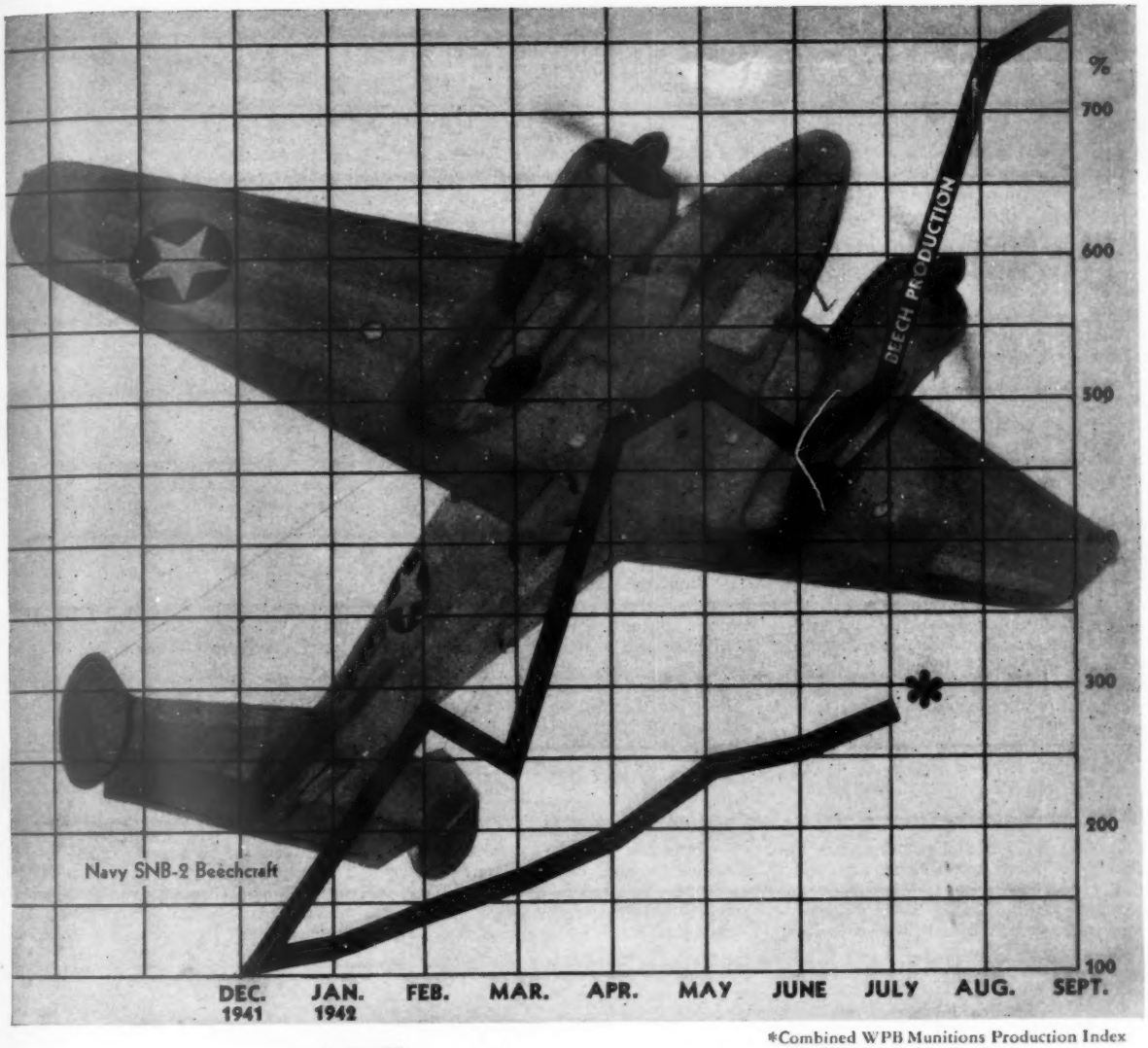
Approaching a row of trees, the pilot will pull up smoothly, timing his movement with an astonishing perfection. One of the greatest hazards is fire. In some cotton fields of the south you can still find the charred remains of ships which caught fire and crashed, carrying the pilots to serious, if not fatal, injuries. Opening the throttle rapidly may cause backfires and these bursts from the engine inevitably throw back sparks which ignite the highly inflammable dust stream.

Farmers will tell you that it's dangerous to smoke on a field being dusted and tell of fires which started in the dust stream and followed the path of the sulphur all the way to its source in the ship, blasting the plan from the air.

A wind of only three m.p.h. can disrupt dusting operations. Always, with the slightest breeze, the dust is dropped so that any drifting will overlap the last swath and leave no strip undusted. You can tell a good duster, like any crafts-

FLYING

"I almost crashed into the loveliest mountain once . . ."



*Combined WPB Munitions Production Index

Performance

Like the aircraft it makes for our country, the Beech organization has demonstrated a high performance factor. The graph above indicates the rate-of-climb of Beech production in the first year of our total war.

Beech Aircraft

CORPORATION

BEECHCRAFTS ARE DOING THEIR PART

WICHITA, KANSAS, U. S. A.

man, by his ground results. Heavy layers of dust in one part, thin layers in others and no dust at all in some places belie the inexperienced, the careless or the "gyp" duster. And there are gyp dusters!

"Outlaws," the regular dusters call the less conscientious flyers. Many farmers are disgusted with dusting simply because some fly-by-night crop duster talked him into a job, showered his land with dust and disappeared before the farmer could actually see the results. Usually the "outlaws" cut prices, do slipshod jobs and fly dangerously old crates. They are the ones who put the blight on dusting, honest operators declare.

The things that can happen to a duster and make his end very sudden and final include fire, striking obstructions, getting confused and closing the throttle on the top of a turn when in reality it was the gate valve he wanted to close, and becoming sick and blinded by dust. What, then, makes the business so attractive?

In the first place there is a thrill in dusting, in flying a few feet off the ground at a terrific speed, in watching great rolls of dust pour out behind you. Next, it pays rather well. Average pay is a flat $300 a month with a bonus of a penny an acre for his work.

Now that there's a war on, dusters are leaving their work to take an active part. Only recently Buster Trimble, one of the most widely known dusters in the south, was killed in England flying with the RAF. Others are in the Ferry Command flying bombers across the ocean. Henry Elliot, dean of dusters, is still in Monroe, La., working for Delta; Red Morris, another widely known duster, has become a pilot for American Airlines and Luke Carutheres is a captain on Delta's airline.

The pilots talk of the late Phil Fairless and some of his experiences. Once Phil landed at a farm to do some dusting and picked a field which contained the farmer's prize pig. He hit the pig, killed it and cracked up the ship. After working all night, he finally got the ship repaired and on landing on another part of the farm hit a hayrake. Phil later was killed in a flying accident in Florida, burning to death in a dusting ship. Ralph Hall, another oldtimer and now a captain on Eastern Air Lines, was dusting near West Palm Beach, Fla., when his ship caught fire in the air and crashed. As it hit, Hall loosened his safety belt, jammed on his brakes and was thrown clear. Critically burned, he was in the hospital for a year. On the day of his release he went back to flying.

Another flyer noticed a slight vibration on the controls. Looking back he was amazed to find the whole rear of his ship in flames. He poked the nose down and continued flying, heading for a cotton field. Almost before the ship stopped rolling, he was out of the cockpit. Hitting the ground on his feet, he ran and, as he did, the ship blew sky-high.

The death rate is rather high. Seventeen dusters died in one season, according to CAA figures released some time ago. Most of these were of the "outlaw" class. The established firms with good equipment and strict flying rules have excellent records. All dusters must obtain waivers from the CAA permitting them to fly at low altitudes.

The boys must work fast and furiously once they are in flight. A good day's work is 600 acres and they dust about one hundred acres in 12 to 15 minutes. It can be safely said the average dusting day is from dawn to 8 a.m. and during the moments of sundown.

Asked why so many dusters die in action, oldtimers replied, "Pilot trouble, buddy, pilot trouble." A duster, they claim, is only as good as he is on the controls. It takes three full seasons of dusting to make a good man, they further claim. Young pilots have the idea that all they have to do is present themselves to some firm, slap down a commercial license and go to work. Not so, the boys will tell you. The firms pick their men as carefully as the Army selects pilots. Erroneous too is the idea that a young pilot can rig up an old ship and become a duster. Although it *has* been done, it's *not* the best way of starting.

• END

The Civilian Instructor Comes Through

(*Continued from page 56*)

there, except for the patience and ingenuity of their first civilian instructor. Perhaps as beginners they were on the border line. Perhaps a lesser man, discouraged by their initial failures—taking them for Joe Dodoes, not Clair Chennaults—would have washed them all out and been done with it.

The experience of the instructor allows him to discriminate. His is the decision to determine in less than 12 hours whether the student should have $25,000 or $30,000 invested in him as a pilot, or whether the great sums expended on his training would be better invested in making him a navigator or a bombardier. His experienced decision is, therefore, of untold value to the Government and the taxpayer alike.

Infinitely more important is the life of the student which may be in the balance. The instructor must look into the pilot's physical, mental and psychological makeup. He must read dangerous present tendencies in the light of dangerous future developments. If, under the instructor's uncanny magnifying glass, the student shows the slightest tendency to be a menace to himself and others in the air, the instructor's answer is: "Stop now. Do not go on to harder courses and kill yourself and maybe someone else. You are much too valuable as a man to blot yourself out so easily."

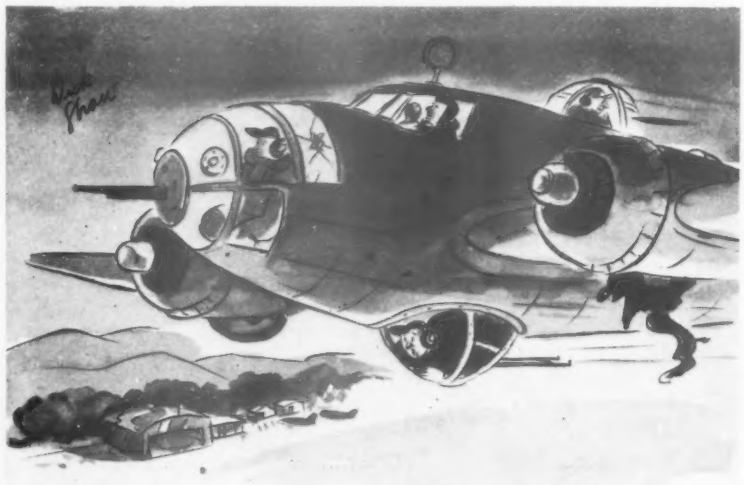
But at the same time, in the brief period allotted, this man must give his student every benefit of the doubt, packing behind him all of his energy and experience to make a pilot of him if it is at all possible.

The lines of distinctions which an instructor must draw are as infinitesimal and hard to define as the shades between certain knowledge and doubt in the human mind. Yet upon them depends our ultimate victory in the air.

When that victory comes, over Berlin, Tokyo, and the far-off outer pockets of the sky, it may be traced back directly to the man who first writes "S" for satisfactory on his student's gradeboard in a primary trainer; to the man who, when sending his future ace up for his first solo, often says:

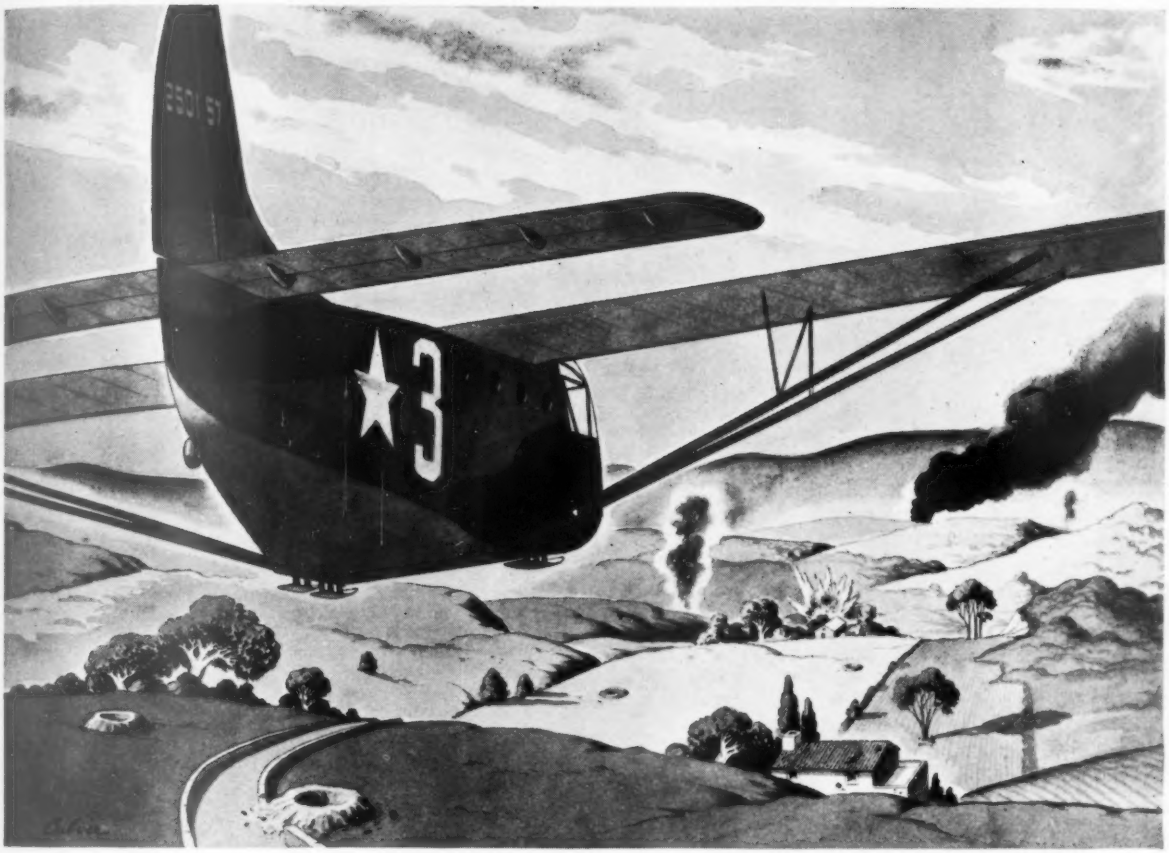
"I'm getting out of the front cockpit and asking God to get in. God knows, you'll need Him!"

END



FLYING

"Attention all crew members! Prepare for a belly landing!"



...WHERE PLANES FEAR TO TREAD

Waco gliders rush in where planes fear to tread. Swiftly and silently—on "postage stamp" fields that might spell disaster for transport planes—they can land their crews of tough fighting men to hold advanced objectives until reinforcements arrive.

The value of this newest phase of modern warfare has been fully demonstrated. That's why, today, Waco and many other of the nation's leading aircraft manufacturers are now producing 9 and 15-place, *Waco-designed* gliders in ever-increasing numbers.

Meanwhile, we aren't forgetting our obligation to the CPTP operators who are using Waco airplanes.

We can't furnish new trainers at this time, but we will certainly do our best to keep present ones in the best of condition by giving prompt attention to your parts and service needs.

THE WACO AIRCRAFT COMPANY • TROY, OHIO

WACO AIRPLANES

The girls of the RCAF's records office can locate any member of the air force through this index file system.

Girls of the RCAF's women's division are shown making electric sorting and tabulating machine cards of the men's records.

AIR FORCE ON FILE

by JAMES MONTAGNES

On a file somewhat similar to that of our FBI, the Royal Canadian Air Force keeps a check on its far-flung flying personnel.

If all other identification is lost, this RCAF officer could be identified through his fingerprints kept on file in Ottawa.

THE Royal Canadian Air Force prides itself on the fact that it can, at a moment's notice, tell you where each and every one of its tens of thousands of airmen trainees are on this continent. Trainees embrace not only Canadians, but also men from Great Britain, Australia, New Zealand, Rhodesia and other parts of the British Commonwealth of Nations. Keeping up-to-the-minute tab on each and every one of the airmen and airwomen under RCAF jurisdiction has become an important job now that they are scattered on fighting fronts throughout the globe.

Records are usually considered a dry and dusty business, but the RCAF keeps it a very live and up-to-date business. From every part of Canada and the United States where there are RCAF, RAF, Royal New Zealand Air Force or Royal Australian Air Force men stationed, and from each of the RCAF operational stations overseas, the records branch at Ottawa receives daily reports of all changes in station personnel, and since there is a constant changing of personnel at RCAF stations, the job of the records branch is a steady race to keep changes up to date.

Once trainees from other parts of the British Commonwealth leave Canada's shores, their records are no longer an RCAF responsibility. As Canada's own personnel moves to distant battlefronts throughout the world, the difficulties of the maintenance of up-to-the-minute records at Ottawa increase in proportion to distance. Thus, while every effort and device is used to answer all questions, official and otherwise, from their own records, reference to RCAF headquarters overseas often becomes necessary where delay in receipt of information has occurred.

The records branch before the war was a little known unit of the RCAF, for there were less than 4,000 in the RCAF at that time. When in December, 1939, it was announced that Canada would be the air training base for the British Empire, it became necessary to set up a greatly modernized records branch to be able to adequately handle the large number of men it was planned to train. Accountants, personnel specialists, business machine experts, fingerprint experts and other highly skilled professional men were called in to form the new records branch. Today the records branch is a hive of activity with about two dozen officers and close to 500 members of the RCAF women's division and civilian girl operators working in three daily shifts in one of Canada's temporary wartime structures on the outskirts of Ottawa.

To keep the system in operation an assembly-line technique has been developed and every type of machine which would be of use in rapidly compiling records was put into operation. The record starts with the moment a recruit is given papers to fill out and goes right through to the time when he is discharged or killed in action. It involves not only keeping a record of his progress through the RCAF, his various postings, his training activities, his identification card with photograph and

(*Continued on page* 122)

Tonight's lesson for Japs

. . . subtracting Zeros

A great guy takes off, and a headline is in the making . . . a headline about courage and spunk and Army Bell Airacobras that help him shatter Jap Zeros into "kingdom come." From General MacArthur's Headquarters, Australia, October 12th (A. P.) comes news of the citation for "gallantry in action" of this Army Pilot:

> Capt. Mainwaring was leading a flight of Airacobras over New Guinea on May 29 when one of his planes was attacked by eighteen Jap fighters. Turning back he shot down the leader of the enemy formation and scattered the others. He then reformed his own group and made a co-ordinated attack, destroying three more and possibly shooting down two others.

Under control of the Airacobra pilot is one of the world's hardest-hitting fastest-moving one man arsenals. Forward is a powerful cannon. Flanking him are heavy machine guns. Around him is protective armor and behind him is an outstanding record of Airacobra success in combat.

The day is coming when Allied Victory will end this war. An advanced world of air-borne commerce will follow. Then, all of our engineering skill and resources will turn from the needs of war to building planes for the needs of Peace. © Bell Aircraft Corporation, Buffalo, New York.

Airacobras for victory—

FUTURE PLANES FOR PEACE

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

WARHAWKS—Everywhere!

Wherever the enemies of democracy attempt to strike—in the Arctic's sub-zero wastes or the desert's blistering battleskies—Curtiss P-40 Warhawks are meeting and defeating every type of fighting ship they encounter. The world's finest combat pilots share credit for this remarkable record with the thousands of Curtiss workers who are building these world-famous fighting ships in quantities unprecedented in the annals of aviation.

For outstanding accomplishment, Curtiss-Wright Buffalo workers are now proud possessors of the new joint Army-Navy Production Award.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION

Send 10¢ for "Men and Wings"—a fascinating 96-page history of aviation by Assen Jordanoff. Airplane Division, Dept. M., Curtiss-Wright Corp., Buffalo, N.Y.

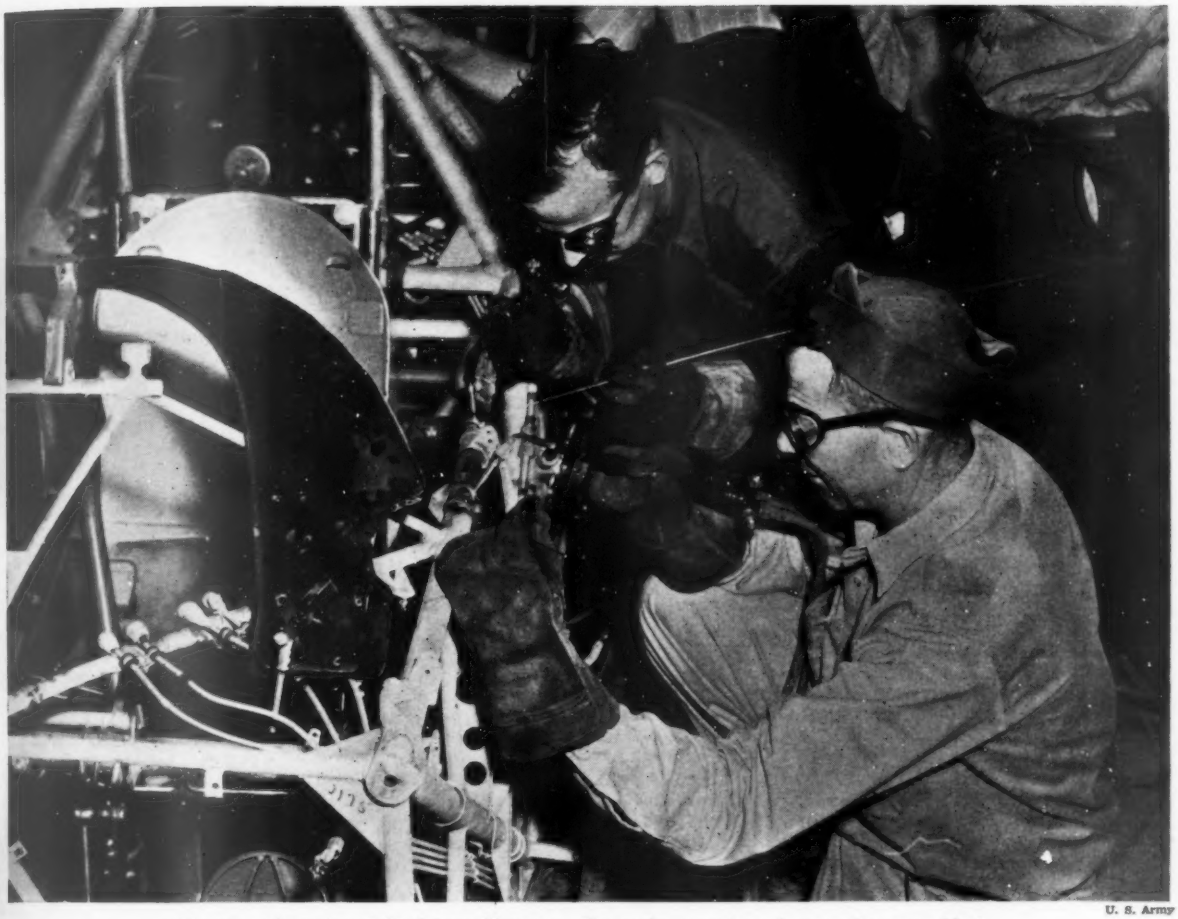
FIRST
Since the Birth of Aviation

1932 • The first Curtiss plane designed specifically as a fighter-bomber . . . a single seater, it was used by the U. S. Navy for operation from aircraft carrier.

1937 • First fighter-bomber to use retractable landing gear—used by the Navy and by China, Argentina and Siam. Wing bombs were also carried.

1938 • The Hawk 75 . . . a monoplane fighter-bomber, incorporating heavier defense armament, increased maneuverability and carried a greater bomb load.

1940 • Curtiss P-40 Tomahawk . . . equipped the R.A.F. in the middle East and the American Volunteer Group in China, Java and Burma.



U. S. Army

The prompt repairing of this damaged longeron will go a long way towards preventing an accident.

Maintenance Cooperation

by ROBERT J. CURRY

Maintenance is a cooperative problem which is only successful if mechanic and operator work as a team.

INSPECTING 65 planes a month for a repair station and keeping track of the mechanics that work on them gives a fellow a different slant on the maintenance problems. When the other man's troubles are brought to your attention by actual contact and you can analyze not only the trouble but the cause of the trouble and a method of preventing it from happening again, you begin to see for the first time how true the old saying "An ounce of prevention is worth a pound of cure" really is.

With the rapid expansion of the CAA War Training Service and the heavy demands of the Army and Navy on our mechanics, the comparatively few men who hold aircraft and engine mechanic's certificates are finding that they have a job to do beyond anything they ever dreamed of. Part 50 of the Civil Air Regulations states that there must be a licensed mechanic for each five airplanes operated. This figure originally was set up as the maximum, but with the shortage of trained men today this quota of five planes to the man is getting to be the minimum. Maintaining five airplanes that are flying an average of six to eight hours a day is a real job for an experienced mechanic, and if he is to do a good job and keep his ships in A-1 condition he is going to have to plan his work, and follow that plan religiously.

A good motto for the mechanic to follow can be taken from the warning advanced by a writer signing himself "Brownie," who has this advice for motorists every day in the Milwaukee "Journal": "Don't put off for a day or so a repair or maintenance job that may cause an accident to you or someone else." This saying will be more and more applicable to aircraft as the flying program is speeded up.

A maintenance job that is serious is corrected at once. No mechanic is going to risk the life of a pilot or student by sending him out in a faulty plane. However, in the rush of getting the ships on the line and keeping them in the air, how many small jobs are postponed until a later date when there is a high wind or low ceiling and the mechanics can have the planes all day?

I have found that there is a definite opinion among certain mechanics and operators that a plane is entitled to show a certain amount of wear and tear proportionate to the number of hours it has

flown. This theory goes back to the early days of aviation when the life of a plane used for student instruction was 1,000 hours, after which time the operator let some private owner have it at a rare bargain and the poor owner spent his income from then on buying parts, trying to keep the plane in the air.

Live-wire operators and mechanics who are on the job have found that it is possible to fly a plane 2,000 to 3,000 hours and still have a plane that presents a pleasing appearance and is as tight and sound as a new one just out of the factory. I mention 2,000 to 3,000 hours not because I think this age marks the end of the plane, but because I know of planes with this number of hours spent in student instruction that are as good today as when they were first purchased. Planes maintained in this condition pay off in very definite ways:

First, by continuous, progressive maintenance the planes will present a business-like appearance and maintenance itself will be easy because there will be no major repair necessary. The cost of reworking a worn out plane is prohibitive both in money and in time; but, if an hour or so a day is spent on each aircraft and the periodic inspections include any necessary adjustments, there is no reason to find your planes in need of a major overhaul. Operators usually depreciate their lightplanes at $1 per hour and after 2,000 hours most lightplanes are marked off the books. But if that plane is still in first-class condition this $1 an hour is going to look good on the profit sheet each month.

Second, by continuously maintaining your planes in first-class condition you will automatically build up a feeling among your pilots and students that will pay big dividends. I know of one operator who has adopted this policy. In talking with his pilots the conversation on several occasions has turned to offers they have received of new jobs, most of them paying more money, but in each case the pilot has expressed the opinion that the comfort and ease of mind of knowing that he is flying the best equipment available and that the equipment is maintained in the best possible condition is worth lots more than the promised increase in salary. This operator has had a surprisingly low turnover in pilots, and those who do leave are the pilots who are on their first program and are getting experience so that they can go on to other advanced programs. His experienced pilots are looking for homes to buy, and when a pilot starts looking at real estate you can bet you have done a good job of selling him on your organization.

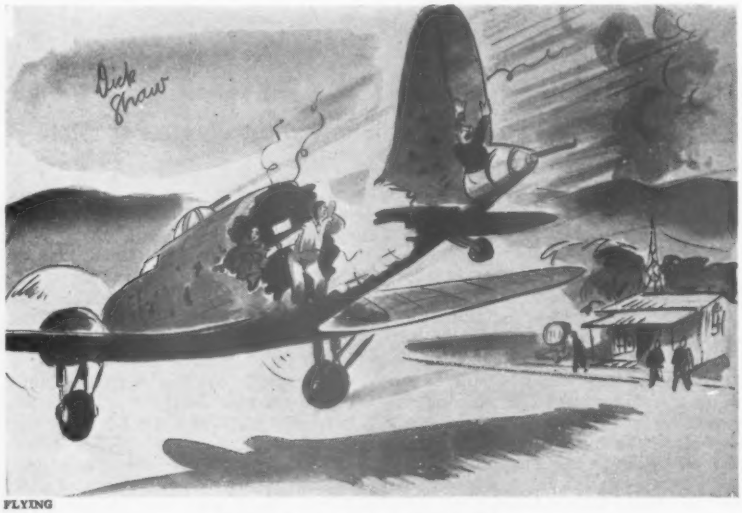
The third and most important dividend is the safety record. Maintenance has contributed more to the dropping of insurance rates than any other single factor. Any pilot who is working for an organization with a policy of grounding planes for minor adjustments as soon as they are found, instead of saying, "Oh, that is okay, we will get that tonight; it probably won't cause any trouble," is going to be safety conscious. Probably it won't cause trouble but the attitude will breed contempt for the regulations of safety. Pilots take a chance. Students fail to see where all regulations apply to them, and sooner or later there is a serious accident or a series of small ones on the field. These may be minor, but they will definitely hurt the operator's reputation and will lower the morale of the entire organization. So much for the pilot angle. The mechanics themselves have been able to keep the planes up to a point where there have been very few aircraft or engine failures, and a failure due to maintenance is getting to be a thing unheard of among good operators.

During the past few weeks I have been taking careful notice of the minor items of maintenance. I have noticed in particular that the small operator who has not had too much maintenance experience is running his daily inspection without taking the cowling off the engine. This neglect so far has not contributed to an accident at his airport, but think how easy it would be for a weak engine mount to fail during the late afternoon when the students are all on their solo practice. Failure to inspect the plane prior to flight in the morning would permit early students to go up in that plane and a probable engine mount failure would be the result, with the loss of the engine during flight and perhaps a fatal accident. A stray drop of water or a half thimble full of sand in the sediment bowl looks innocent enough, but that sand got in there somehow and there is a good chance that there is plenty more where it came from. The sediment bowl is going to catch most of this but forced landings have resulted from not draining the gascolators. The accident you cause by skipping what appears to be a routine and unimportant inspection may be fatal to a pilot and a student.

With the shortage of trained mechanics it is going to be necessary that each man be permitted to do the best possible work with the least interference. On too many occasions I have found planes that have been taken from the shops before the mechanics released them because the pilot had an appointment with a student and didn't think that he ought to wait until the mechanic had finished. This is one of the worst possible situations that can exist on any operation. The certificated mechanic is charged with the maintenance of your equipment and that equipment must be signed for by him certifying that it is airworthy and in good condition. Is he going to do a good job if the plane is taken out partly finished and he has to battle with an instructor all day to finish the repair? More than one operator could trace the inefficiency of his shop to his pilots. Practically every operator has one or more extra ships, yet I have seen pilots in the shop insisting that their ship be put on the line, in spite of the fact that it was not finished, when one of those extra ships was on the line ready to go. Each pilot has a plane that he is using daily and likes better than the others. It is good business to let him have that plane as much as possible, but when a pilot gets to the point where he can't fly or instruct unless he has that particular plane it is time for the management to step in and find the reason why.

With the rush to get programs finished, pilots get very little actual flying. Most of it is done by the student or with the student following through on the controls. The pilot is concentrating on the student and not the plane and when he lands he can't tell you very much about the plane itself other than it tuned up okay and flew. A good operator has started requiring that each pilot put in at least 30 minutes a day solo in his ship. This has paid him well, for in flying the ship solo a pilot will notice loose parts, rigging and the entire action of the ship. One pilot reported that his plane was flying right wing heavy, but he had not noticed it before. I had occasion to fly this particular plane a week previous and know

(*Continued on page* 142)



"Captain says a little more left rudder!"

worth waiting for!

"Maybe I should have asked for deferment . . . it will be lonely for Janie and little Sue. Yet, unless some of us go, *they* will come here and that is unthinkable. It's better to fight it out on their doorstep than mine! And when I come back I'll know that my loved ones and my country are safe . . . that, to me, is Worth Fighting For. . . Worth Waiting For!"

Culver, too, has gone to war. But when Peace comes you will see the new VICTORY *Model Culver* . . . a cleaner, more efficient cross-country airplane than ever before. And when you see it you'll agree that it, too, was

worth waiting for!

UNDER CONTRACT TO THE U.S. ARMY AIR CORPS AND THE U.S. NAVY

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CULVER AIRPORT — WICHITA KANSAS

LET'S GO! U.S.A. · KEEP 'EM FLYING!

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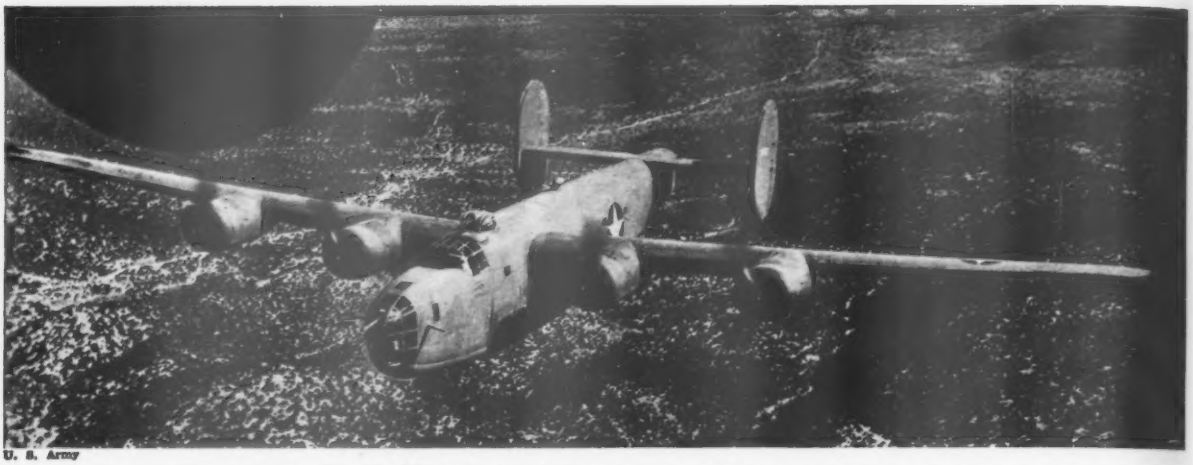


U. S. Army

Once a bomber like this B-24 "Liberator," Old Bolts' career started when she became a cargo ship.

'OLD BAG OF BOLTS'

by Maj. BEN H. PEARSE

Through special arrangement with Air Force

They don't award medals to airplanes but the "Old Bag of Bolts" is one ship that might well get a deserved Congressional Medal of Honor.

SHE was blessed with an assortment of names. To many she was "Old '76." Some called her "Red Cap" and others "The Gravy Train" because she carried so many important personages to the four corners of the earth. But the name "Old Bag of Bolts" seemed to fit her best.

Officially she was just A.C. Serial Number 40-2376, a B-24 airplane with a history all her own, as can be vouched for by the scores of men, women and children whose lives she saved—ferry pilots in the North Atlantic, combat crews and refugees in the South Pacific.

It is anybody's guess what the enemy might have called her. Old Bolts seemed to have a charmed life while she was trucking precious cargo all over the Pacific combat zone in a dangerous game of hide and seek with the Jap aircraft during those first hectic days of war.

Squat and lumbering on the ground, she would waddle up to the head of a runway like a duck out of water. But once her ponderous landing gear was tucked away, she was a creature transformed—maneuvering her big hulk with the lightness of a toe dancer.

When Bolts was turned over to the Ferrying (now Air Transport) Command one day last year, months before Pearl Harbor, she had already cut her eye teeth on dozens of missions. She had reached middle age for a plane of her type, but it was just another case of life beginning at 40.

As a Ferrying Command ship, Bolts had no regular run. Home was any place she plumped her wheels down. And it was here, there and everywhere on short notice. Her crews had uncalled-for laundry all over the globe. Their baggage included fleece-lined clothing and boots for the Arctic, shorts and mosquito boots for the tropics.

Bolts knew what it means to labor along through the heavy fog and mist of the North Atlantic burdened down with tons of ice. On the South Atlantic run her paint blistered under the equatorial sun; her motors choked through dust storms and wallowed through thunder squalls where St. Elmo's fire played about the leading edges of her wings and zigzagged eerily across the windshield.

Her crews ate quinine instead of candy as she shuttled back and forth from Washington to Cairo over steaming African jungles and shimmering desert sands. Now and then they would zoom her low and let her chase herds of giraffes to break the monotony. With little more than a wrench and screwdriver to work with, mechanics would jump out almost as her wheels touched the ground, then sweat in the torrid shade of her wings to change a cracked exhaust brace or broken stack, replace an oil valve, change spark plugs, service the oleos and clean the strainers.

So thoroughly did the factory workers who put old Bolts together do their job and so thoroughly did her own mechanics sweat that her pilots were able to report at the end of each leg of each flight, under the heading of "Mechanical Difficulties," the sweet monosyllable "None."

Not that Bolts didn't have her moments. Back before her South Atlantic and South Pacific adventures, for instance, on that transatlantic round trip to the United Kingdom. She held ferry pilots as passengers and the trip was routine until two hours out of Montreal on the return hop.

From landfall on the coast of Labrador there had been intermittent, moderate icing of the rime type. Then things began to happen. Without warning, the rime crystals changed to hard clear ice, formed from large, supercooled rain drops. Bolts was laboring. Second Lieut. C. W. Dean, co-pilot, turned on the de-icer fluid for her props and the boots on the leading edges of her wings and tail, but the altimeter needle kept sinking. Lieut. James W. Anderson, pilot, pushed forward the throttles as the needle continued to turn slowly downward. At last, when the throttles were wide open, the needle stopped. Dean and Anderson breathed a sigh of relief.

The coating of ice, visible with a flashlight out the side windows, wasn't getting any thinner. Anderson decided to turn around and try to get out. Bolts reacted sluggishly to the controls. It was like traveling down stream in a heavily loaded canoe, but she made it without losing any of her skimpy altitude. Then, for four hours, Bolts was lost.

Second Lieut. A. H. Anders, navigator, kept looking for a break in the white mist that would give him a chance to get a fix. Staff Sergt. James A. McVicar, radio operator, listened in vain through the sputtering static for a signal that

(Continued on page 110)

Silently through the Night

Tons of war materiel and thousands of fighting "Air Commandos" will be transported, day and night, quietly, swiftly and efficiently in gliders built by Commonwealth.

That's the job we're doing . . . and that's the job we will continue to do until this great battle for freedom is won.

After that, Commonwealth will build airplanes for private pilots . . . the kind of airplanes private pilots want . . . airplanes whose name will be synonymous with quality, performance, dependability.

In the meantime, prepare for the day you can buy a Commonwealth airplane . . . buy all the War Stamps and Bonds you can TODAY!!

COMMONWEALTH AIRCRAFT, INCORPORATED

Formerly Rearwin Aircraft & Engines, Inc.

Kansas City, Kansas, U. S. A.

C. H. DOLAN II, President

Times Have Changed!

★ Yesterday our nation was at peace—following our usual peace loving, easy going habits. TODAY, we're at war . . . cruel, relentless war!

★ Yesterday, this company was producing Cloudsters and Skyrangers . . . airplanes for private pilots. TODAY, we're building gliders for our armed forces.

★ Yesterday, this company was known as Rearwin Aircraft & Engines, Inc. TODAY, our name has been changed to COMMONWEALTH AIRCRAFT, INCORPORATED.

Yes, times HAVE changed

would give an inkling of their course. The Northern Lights had been acting up; sometimes they interfered with reception, sometimes they didn't. Now, of all times, they made his earphones sputter like a hamburger stand on circus day. He couldn't raise a soul.

The passengers in the bomb bay knew well what was going on. If that first long, gradual turn wasn't enough of a tip off, the crashing of hunks of ice thrown off the propellers against the fuselage behind them left no doubt in their minds. Then the utter blackness of their frigid cell was broken by a shaft of light and a cheerful voice from the pilot compartment forward: "Everybody put on your parachutes."

Staff Sergt. D. D. Greenwalt, engineer, watched the dials on the panel before him for the flicker of a needle that would tell him that Bolts was giving up. The ice built up on the engine cowls until it reached the arc of the props and was knocked back inside, but the carburetor stayed out of the danger zone. The de-icing system worked to perfection. As the ice built up on the tail surfaces, Old Bolts would shake herself all over, but her de-icer would break it loose and all would be smooth for two or three minutes. Meanwhile, her four motors roared on in unison with never a conk or sputter.

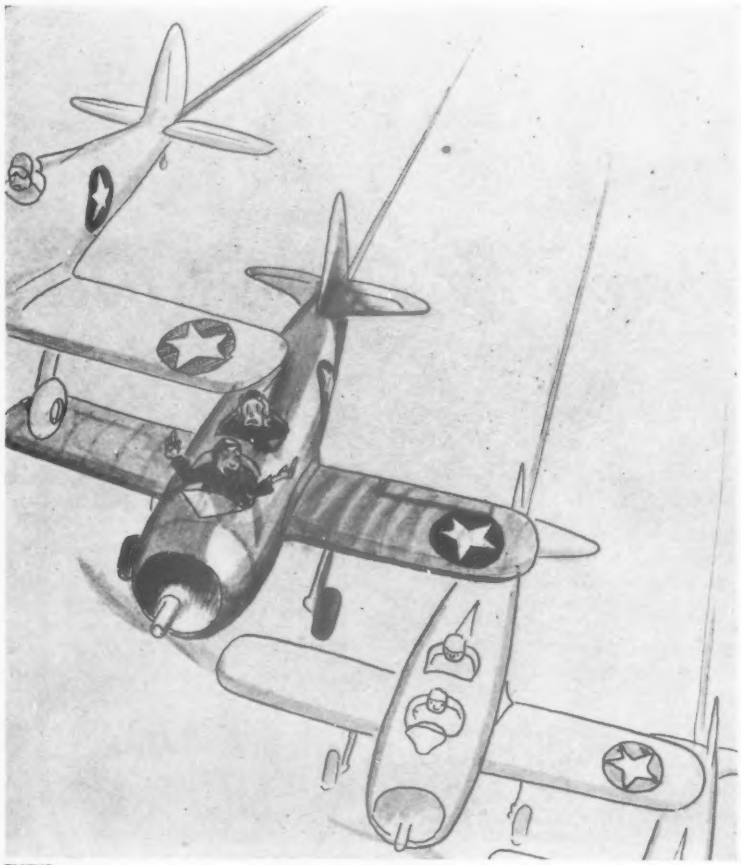
Finally, 15 hours after a take-off that seemed a year away, Lieutenant Anders spied a patch of dark sky and three beautiful stars. He fingered the thumbscrews of his octant, herded the errant bubble between the hairlines of the artificial horizon, and quickly figured on a scratch pad before him until he had a line to draw on his chart. He couldn't tell where he was along that line without a second fix that would give him another line to intersect the first; then X, the intersection would mark the spot, their position. But the break in the clouds was gone now. He waited, eyes glued to that little glass hatch overhead.

The door to the bomb bay opened and Sergeant McVicar appeared, climbing over ferry pilots packed in like sardines. There had been a break in the radio fog, too, and he had a bearing. Would it help?

"Will it help? Hell, yes, it will help."

With his protractor, Lieutenant Anders marked off 194° true from —— and drew a line that intersected his first line. He measured carefully—420 miles NNW of LR in Newfoundland—then leaned over and tapped Lieutenant Anderson on the shoulder.

"Sir, you are now over Labrador flying straight for the Atlantic Ocean. A course of 169° should get you to LR in about two hours."



FLYING

"Look! No hands!"

Lieutenant Anderson nodded without turning around and bore down heavily on the wheel. The ailerons, elevators and rudders on old Bolts were frozen again, as they had been intermittently for the past four hours, but after some tugging at the controls Bolts slogged around like an obedient dray horse and turned her pug nose toward LR. Pulling back on the controls would not raise her nose an inch, but her four motors chugged on through the darkness until she settled herself gently on the mile-long runway at LR.

No sooner had bolts rolled to a stop than goggle-eyed ground crews began arguing whether her coating of ice—two to three inches broken off by the de-icer boots—weighed one, two or three tons.

But Bolts had tougher flights than that before her. Her instructions, to be exact, came in a recorrected copy of Operations Order No. 163. That was December 5, 1941. She subsequently covered nearly 150,000 miles on the grind—it was really one continuous flight—and her engines hardly ever cooled until the very end. Time for her 25, 50 and 100-hour checks flew past unnoticed, all because of the scribbled note that fluttered in the radio operator's hand as he dashed out to Bolts at Trinidad.

"Pearl Harbor attacked by Japanese at 0728," the note read.

The name of Ambassador William C. Bullitt headed the list of passengers as old Bolts roared out over the Caribbean. But famous names were soon to become commonplace with Bolts. At Cairo, on that hop going over, a party of high-ranking officers boarded her for an emergency mission to Australia. Then she was loaded down until her sides were about to pop with ammunition and scores of other items badly needed in a hundred spots in the East Indies.

Maps were scarce, good ones, anyway. Lieut. Ben Funk, the pilot, picked up some information from a Dutch pilot at Karachi, but he still wasn't prepared for that short runway at Calcutta. It was marked "1,000 yards" on his map—barely enough for a B-24 loaded until her tires bulged—but actually it was only 760 yards. Somehow, with plenty of brakes, Lieutenant Funk and Old Bolts managed it—with 100 feet to spare. To get off that runway, Bolts had to leave some gas behind.

On to Rangoon, which the Japs were bombing daily, then to Bandoeng in Java, where the Dutch made quite a fuss over Bolts. They had never seen anything like her 28-ton body close up before. In fact, she was such an unfamiliar sight that an Allied plane looking very much like her had been fired on by Dutch antiaircraft less than a half hour before. But Bolts came in without difficulty. (The other ship went on to Singapore.)

At Soerabaya, the next day, Maj. Gen. Lewis H. Brereton and Maj. Gen. George H. Brett were taken aboard old Bolts for a 10,000-mile inspection trip, 3,600 miles of it in a one-day flight from the west coast of Australia to Sumatra.

There was great need in the Indies for maintenance personnel to service the B-

(*Continued on page* 114)

Top Layer . . . As "umbrellas" for our high-flying bombers and medium altitude formations, *Republic P-47 Thunderbolt* squadrons cover the attack. Enemies reaching for the sun will have slim chance against these fast-charging, 8-gun strato-fighters. The Thunderbolt assures control of the sky.

REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION REPUBLIC AVIATION FARMINGDALE, L. I., NEW YORK

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Get This Flag Flying Now!

This War Savings Flag which flies today over companies, large and small, all across the land means *business.* It means, first, that 10% of the company's gross pay roll is being invested in War Bonds by the workers voluntarily.

It also means that the employees of all these companies are doing their part for Victory . . . by helping to buy the guns, tanks, and planes that America and her allies *must* have to win.

It means that billions of dollars are being diverted from "bidding" for the constantly shrinking stock of goods available, thus putting a brake on inflation. And it means that billions of dollars will be held in readiness for post-war readjustment.

Think what 10% of the national income, saved in War Bonds now, month after month, can buy when the war ends!

For Victory today . . . and prosperity *tomorrow,* keep the War Bond Pay-roll Savings Plan rolling in *your* firm. Get that flag flying now! Your State War Savings Staff Administrator will gladly explain how you may do so.

If your firm has not already installed the Pay-roll Savings Plan, *now is the time to do so.* For full details, plus samples of result-getting literature and promotional helps, write or wire: War Savings Staff, Section F, Treasury Department, 709 Twelfth Street NW., Washington, D. C.

Save With
War Savings Bonds

This Space Is a Contribution to America's All-Out War Program by

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CONSOLIDATED LIBERATOR

Life savers made in the U. S. A.

EVERY American plane turned out ahead of schedule is a life saver! Rohr production fighters who perform the highly specialized tasks of precision parts manufacture and vital assemblies, know this full well. That's why they maintain Rohr output at a pace to give our great pilots ***more*** planes ***faster*** . . . a pace to shorten the war and save American lives.

ROHR

PARTS ☆ ASSEMBLIES

Rohr-equipped planes are fighting, bombing, cargoing their way to a quicker Allied victory!

HELPING TO WRITE THE STORY OF TOMORROW!

Rohr Aircraft Corporation, Chula Vista, California

(*Continued from page* 110)

17's that had come in. Bolts was ordered to go from Australia up into the Philippines and bring out as many key maintenance personnel as possible. That was late January. The ground crews in the Philippines had been removed from Luzon to a secret airport on Mindanao. Japanese-contralled Davao was only 100 miles away. It was a ticklish job, flying in at night, picking up the crews, and getting out unseen. Bolts had no armor, no self-sealing tanks, and only a few machine guns for protection.

Staff Sergts. Leo Zulkowski and Frank Sayko worked all day on Bolts, checking and rechecking for the afternoon takeoff. The motors had long since passed the 400-hour mark. From Australia to Mindanao and back was 3,600 miles, almost all of it over open water. Things had to be right.

Old Bolts made the trip without incident, although Lieutenant Boselli had to change course five times to avoid Jap-controlled areas. During the last lap of the flight, Capt. Hewitt T. Wheless, who had flown every mile of the coast in his B-17, stood between Lieutenant Funk and Lieut. Charles Bowman, co-pilot, to guide them to the secret airfield. Bolts brought out 25 crack mechanics in her bomb bay.

About a week later Bolts was off for Rangoon with Gen. Sir Archibald Wavell aboard. The Japs had raided a field nine miles from Rangoon a half hour before her arrival. Pilot Funk decided to go to a satellite field in Burma to escape a possible followup attack. Luck was with Bolts. That night the Japs raided Rangoon three times. The return to Java with General Wavell was easy.

Singapore fell and the Japs began their first raids on Java. The raids kept Bolts on the alert staying away from her field while the Japs strafed it. When the air raid alarms came, Bolts would lumber out to the runway, take off and fly south over the water and wait for the all clear to be given.

Then Bolts was ordered back to Darwin, departing February 19, the day of the big Jap raid. About two hours out of Darwin, she got radio information warning her not to come in, so she landed a few hundred miles to the south, waited, and then came into Darwin shortly after the attack.

When the Japs went to work in earnest on the invasion of Java, Bolts was called upon for evacuation work. Twice she went back into Java from Darwin, bringing out 20 evacuees each time. Luck continued to ride with Bolts. The day after she left Broome, Australia, with the last lot of passengers she had taken out of Java, Broome suffered a heavy raid. After it was over, she went back to Broome under cover of night to bring out personnel.

Bolts made a second trip to the Philippines. This time she took in sorely needed supplies for the wounded who had escaped fallen Bataan and Corregidor. In addition to her crew of seven, she brought out 30 officers and men from that secret airfield on Mindanao, including Lieut. John Bulkeley of Navy PT boat fame.

That was her last trip for the Ferrying Command. Within a few days her crew was called back to the States and Bolts was turned over to the commander of the Southwest Pacific. When Lieutenant Funk and Bolts parted company they had been together nearly 400 hours.

Bolts made one more daring trip after that, back to the Philippines in another rescue attempt. It was her last.

The gas load gave Bolts only a few minutes to locate the Mindanao airfield. She circled overhead, trying to get a signal through. The Japs were everywhere; perhaps they had taken the field. Bolts didn't make contact in the darkness. She headed back toward Australia.

But Bolts couldn't make it back with the remaining fuel. She headed toward an island for an emergency landing. Her position was radioed to aid in the rescue of her crew.

Then Bolts gave out of gas. She sat down in the water a few hundred feet off shore. After more than 600 hours her motors sputtered for the first—and last—time. And then only because she lacked fuel.

Members of her crew swam to safety and later were rescued by a submarine. Beyond saving was A. C. Serial Number 40-2376.

They don't hand out awards for airplanes, and we don't mean to get sloppy sentimental over a big hulk of steel, but in our books Old Bag of Bolts went down with a Congressional Medal of Honor pinned to her fat chest.

The ranks of the officers and the grades of the enlisted men mentioned in this story were those held at the time the action took place.

END

Aces for China

(*Continued from page* 27)

cadet—without of course the combat experience of the Chinese—takes about 35 weeks to go through the three flying schools. Then this class went on to other fields, such as Dale Mabry at Tallahassee, Fla., for tactical training. Most of these men are now probably back on the battlefront.

As flyers, the cadets leave nothing to be desired. Naturally full of fun when off duty, they are deadly serious in the classroom and on the field pay close attention and take copious notes.

Most of them know little about engines so their mechanical ability does not compare with that of American cadets. Also, in the case of some, their methodical flying and close attention to directions may bring a loss in individual initiative.

To help me learn about their flying characteristics, Major Kanaga called in Capt. Fergus Fay, American flying instructor. Captain Fay, a husky red-head from Texas, with a wide, almost handlebar mustache, talked emphatically about their good points.

"The Chinese have tenacity, alertness and work like the devil," he said. "Their powers of observation are remarkable; show them something and they know it forever. They watch the instructor closely, and learn things that way. Their general attitude is excellent; they are very attentive, and don't get tired on long flights. They're especially good on formation flying, as they are naturally methodical.

"The men have no fear of a plane," the captain went on, "and they don't break any regulations deliberately, but sometimes they don't pay any attention to them. Probably it's just because they're so eager to finish training and return to the fight."

"Are they superstitious?" I asked. "Do they carry charms?"

"No, they laugh at our 'Friday the 13th' and stuff like that. They are well educated, you know."

I talked with Capt. Lee Hsueh-Yen, Chinese commanding officer, and the interpreter, David-Tseng, a graduate of the University of Shanghai. The captain was short and slim; he couldn't have weighed much more than 100 pounds. He was dressed in olive drab trousers, shirt and officer's cap with American aviation insignia. He seemed to know English fairly well, but I put my questions to both men, with Major Kanaga listening in to help.

David-Tseng spoke without hesitation in slightly stilted but good English. "The cadets here," he said, "are what you would call the cream of the crop. They are all graduates of China's 'West Point,' the Central Military Academy established by the generalissimo in 1926. In 1938, this school was moved from Nanchung, capital of Kiangsi Province, to Chengtu, in Szechuan Province, and the cadets had to hike the 600 miles.

"They are paid $50 a month, American money, plus $1 a day for food. China allots them $100 for uniforms. When they finish the three stages of flying training they become sub-lieutenants, what you would call third lieutenants, if you had them. After a year's service, they become second lieutenants."

Captain Lee is 28 years old and had served for nine years in China's army. At 15 he left his home in Kwantung to join the military, but instead landed at a school at Nanking. From there he went to the Central Military Academy, studying aviation under American instructors. He graduated with the second class; the other cadets at Luke, considerably younger men, were members of the 12th class. Captain Lee fought against the communist army, took part in the Sian-Fu coup d'etat when Chiang Kai-shek was captured, and flew against the Japanese in a Russian S-bomber.

(*Continued on page* 118)

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(*Continued from page* 114)

I wondered what part of the course was most difficult for the Chinese, and all three—the major, the interpreter, and the c.o.—agreed it was trouble with the new language.

The cadets spend one hour a day studying English, for the instructors know no Chinese. If any American thinks learning to fly is a tough job, he ought to try it under the same conditions as face these lads at Luke Field—under a Chinese instructor, for example. The command "taoi-san!" wouldn't mean much to us, but to a Chinese it says "jump-umbrella!" and that means it's time to bail out. "But," interjected Captain Lee, "when one of our flyers is in trouble he makes an emergency landing. He's too scared of cactus to bail out." And no one who's seen the tough sharp spikes of cacti would blame him.

An airplane is "Fei-Chi," or "flying-machine." "Give her the gun" is "Kai-Yu-Men," or "open gas door." "Chee-Fei" is "start flying"; while "Loo-Tee" is "drop, land."

The language difficulty is further complicated by the fact that some of the youths, coming from different provinces with varying dialects, had to learn the basic Chinese tongue, Kuo Yu, before they could take instruction.

Chinese is, of course, a sign language, with thousands of characters. The symbol for peace, tranquillity, contentment, for example, is a roof with a woman under it. Put another woman under the roof and you get just the opposite—trouble, jealousy, or even war. A gateway with a mouth in the middle is "to ask"; put an ear in the gateway and you get "to listen."

In order to get the various aviation words and phrases, some of them slang, lined up for the students, a loose-leaf dictionary has been compiled under the direction of Major Kanaga. New terms are constantly being added. The burden of understanding instructions is on the Chinese; all the American instructor has to do is say "Up flaps" and the student must know—through study of a long sequence of complicated characters—what he is to do, at once.

Captain Lee and David-Tseng took me around to have a quick look at the quarters of the Chinese group. At the door of the wooden barracks a soldier called "Li-Chen!" our "'Tenshun," literally "Stand straight!" and the few cadets present jumped to attention until they were put at ease by the captain.

In the building the little cots were lined up, small steel trunks at the base, blankets nicely folded. Officer's caps, bearing the blue Kuomintang (political party) star; blouses with high-neck collars of American old-style, decorated with big wings. The arrangement was much the same as in the other airfields throughout America where British flyers are training, as at Falcon or Gunter fields, or where our own young men are going through the mill at 100 or more schools. The Chinese lads I saw, many of them clad only in trunks, were all short but solid and muscular. The men from Southern China, they told me, are generally short, but among the flyers were a few six-footers from the North.

Captain Lee introduced me to the officer of the day, Cadet Hsiang I-Hsueh, and Cadet Captain Chung Chu-Shih. Something puzzled me, and I put it up to David-Tseng. "How do the American instructors keep track of the names of their pupils?"

The interpreter grinned. "They can't. Certain family names are all pronounced alike. For example, Chang, Chung, Tsung, Chiang, Tseng, Cheng, Chen—are all Tschung!" The word seemed to explode from his mouth. "So the instructors simply call the cadets by their numbers."

It seems a long, dangerous, and costly process, bringing those lads 15,000 miles or so for a few months training. I expressed these thoughts to Major Kanaga on returning to his office.

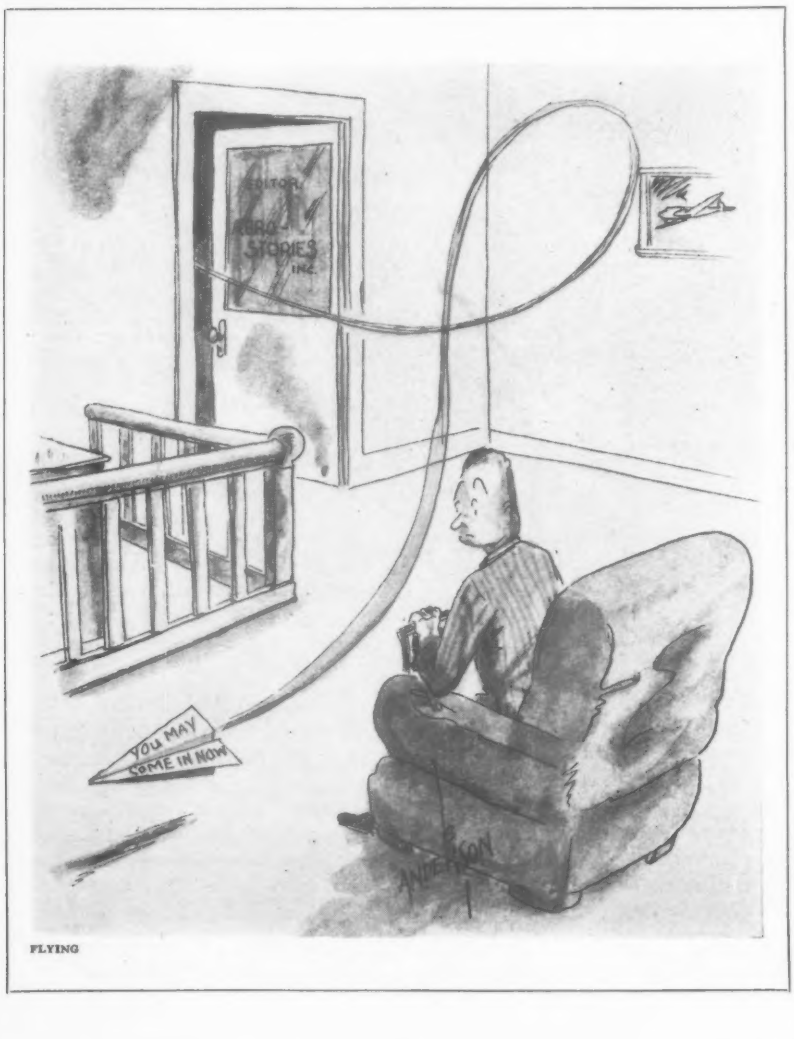
"The role these Chinese students have to play will go far beyond the war," he explained. "They are being trained as liaison men who will bring together the United States and China in closer bonds than ever before, after the victory. They will know both Chinese and American languages, customs and peoples. They will know aviation, which is going to have a tremendous and vital part to play in the remaking of the post-war civilization. This is one of the greatest, most hopeful and most enduring features of this entire program."

But their immediate and most important job—that of beating the Japs—was brought before them dramatically on the day the first class at Luke Field graduated. The ceremonies, though brief, were most impressive. High officers and officials were there, among them Maj. Gen. Ralph P. Cousins of the West Coast Air Training Center, Maj. Gen. T. H. Shen of the Chinese Aeronautics Commission to the United States, and Lauchlin Currie from Washington, representing President Roosevelt.

"Take back to your people," General Cousins said, "the message of how fully we feel bound to them in this fight. Tell them how we are hurrying to join their ranks, that they will not fight alone any longer. . . . From now on until victory, war is our business—the business we have been trained for. There can be no other business, no other motive which will turn us back from that definite objective.

"Go back and give 'em hell!"

END



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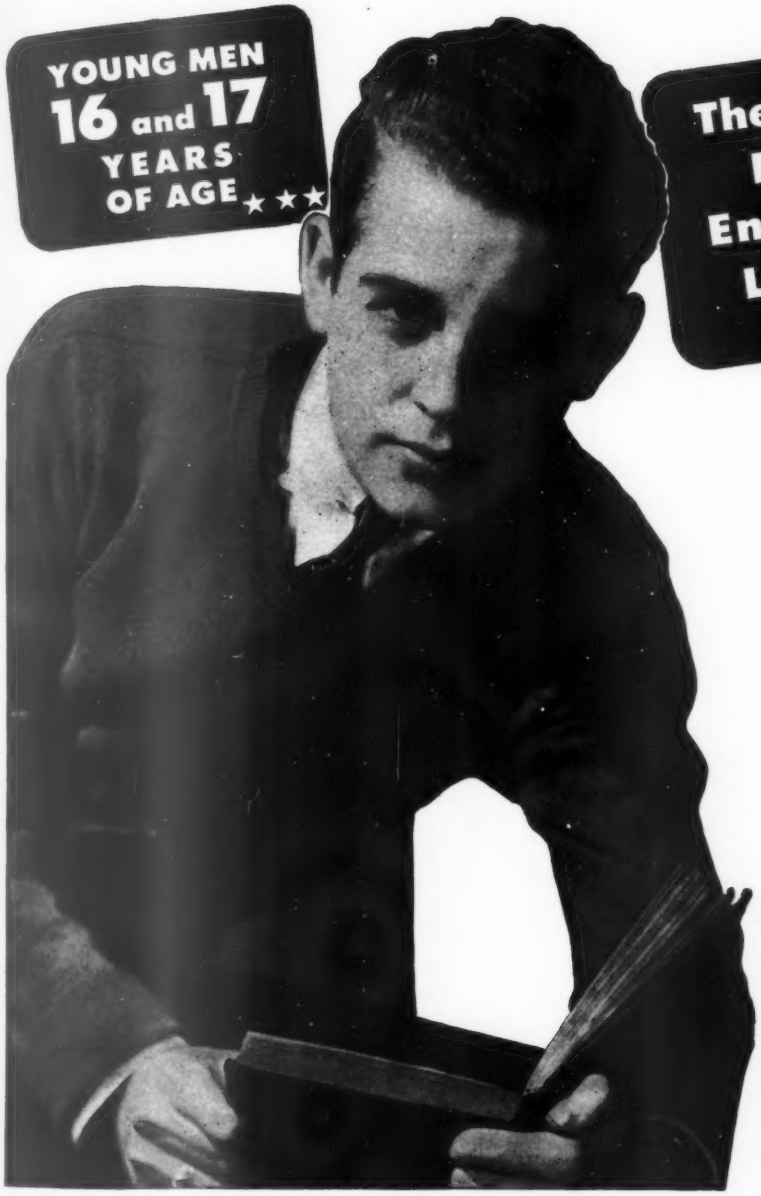

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The Hurricane

(*Continued from page 28*)

fabric covering has been changed to metal, with a consequent increase in strength.

Certain minor detail improvements as the result of service experience were gradually embodied, including streamlined exhaust manifolds, enclosed mass balance for the rudder, and improved wind shield and cabin top to provide a better line.

With the advent of later developments of the *Merlin* engine the performance and suitability of the *Hurricane* increased. The original two-bladed wooden propeller was replaced first by a two-position propeller and later by a three-bladed constant speed propeller. The eight guns were increased to 12 machine guns, six in each wing, and a further variant of four 20 mm. cannon guns, two in each wing.

weight of the prototype *Hurricane* was 6,000 pounds. The latest version is approaching 10,000 pounds and the only structural alterations necessary to accommodate this enormous increase have been of a minor nature.

The original prototype had a top speed of 325 m.p.h. at an altitude of 16,500 ft. The latest versions—full details of which cannot be given—have a speed of 325 m.p.h. plus, and at varying altitudes dependent upon the type of power unit.

The first squadron went into service in 1937, and one of the most spectacular events of the following year was a remarkable demonstration of the qualities of the *Hurricane*. In a northerly gale the distance of 327 miles from Edinburgh to Northolt was flown by Squadron Leader J. W. Gillan in 48 minutes at an average

The Aeroplane

Immediate predecessor of the "Hurricane" was the Hawker "Fury," almost a biplane "Hurricane" externally. Maximum speed of the "Fury" was 240 m.p.h. at 14,000 feet.

It is interesting to note the enormous advance in fire power, as compared with the fighters of a few years ago (of which the *Fury* is a typical example):

Type	Weight of Armament and Ammunition Pounds
Fury II	196
Hurricane I ...	461
Hurricane IIB.	696
Hurricane IIC..	876

Each machine gun has a rate of fire of 1,100-1,200 rounds per minute, and each 20 mm. cannon fires at the rate of 600 projectiles per minute.

The process of evolution has proved definitely that to design with something in reserve to provide the additional factors necessary to meet the inevitable call for increased loading under war conditions is a wise precaution. The gross speed of 408.75 m.p.h. Flying at an altitude of 17,000 feet, the pilot had to rely mainly on his instruments for navigation as the flight was made in the dark, and several minutes were lost due to the fact that he overshot the aerodrome and the recorded time was taken at the actual landing.

The *Hurricane* design was the subject of criticism from certain European sources, in particular the French journal "Les Ailes," which expressed the opinion that the machine was too heavy to be maneuverable and too powerful to have the range necessary for making contact with the enemy. It was regarded more in the nature of an experimental speed airplane and not a truly military aircraft, the more so as the practical conditions of pursuit at speeds approaching "limiting performance" were still unknown.

That this criticism was completely wrong is proved by the fact that in the first year of the war *Hurricane* squadrons had to their credit almost half the confirmed victories in the air against German fighters and bombers.

In the development of the *Hurricane* special attention has been paid to the necessity of providing armor protection and this feature became increasingly desirable as a result of experience under actual fighting conditions. Armor plating of varying thickness is embodied as part of the structure on certain vital points of the aircraft, and bulletproof wind shields are fitted on every machine. The latter feature has provided some remarkable evidence of its value. Sydney Camm has in his office a windshield into which no less than three bursts of machine gun fire had been sent, and in no instance had a bullet completely penetrated.

The development of this feature, simple as it may appear, was no easy matter, as it was essential to retain clear vision; considerable scientific research was carried out before the requisite qualities were finally embodied.

During World War II the *Hurricane* has been in action on 20 different battle-fronts and under widely differing climatic conditions. In extremes of weather, from the ice-bound north to the tropical regions, the type has proved itself reliable and trustworthy and, especially adapted to meet these changing conditions, has carried out its functions with exceptional efficiency. The term "ubiquitous" is frequently misused but it is not misplaced when applied to the *Hurricane*.

It was the only British single-seater monoplane fighter to operate in France and Norway. In the Battle of Britain it bore the brunt of the attack and *Hurricane* squadrons formed the backbone of the force against which the Luftwaffe broke and was finally defeated.

One of the spheres in which the *Hurricane* has rendered most valuable service has been night interception of raiding enemy aircraft and long range intruder work at night over enemy aerodromes. The suitability of the type for this class of work is in no small measure due to the good all-round field of vision which the pilot enjoys and the comparatively low stalling speed. Its approach is reasonably silent and its devastating firepower so great that one burst is usually sufficient to send the enemy to destruction.

A further version known as the *Sea Hurricane* is utilized for the protection of convoys. This particular type is a standard *Hurricane* with the addition of catapult spools, slinging gear and in some cases deck-arrester gear. It has been responsible for the immunity from air attack which Atlantic and other convoys have enjoyed in recent months.

The latest purpose for which the *Hurricane* has been adapted is high speed bombing, including low altitude, precision and dive bombing. This type is familiarly known as the *Hurribomber*, and in this guise has achieved notable success against land and sea targets. For ground strafing purposes the type has proved unequalled, and the concentrated fire from its cannon or machine gun armament has wrought

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death and destruction to the enemy on all fronts.

Another fact not generally realized about the *Hurricane* is that it has quite a long range. This enables it to extend its sphere of activities and the adaptation necessary to equip the machine for this class of operation was carried out without in any way detracting from performance or maneuverability.

It is not at this stage possible to indicate in which other directions the *Hurricane* will prove of value. The development of strategy and tactics will open the field for further adaptations of this remarkable airplane and it is safe to assume that more will be heard of its exploits in due course.

The *Hurricane* has not only proved itself popular with the pilots of the RAF, but it has been generally acclaimed by every section of the allied air force to which it has been allocated. The sense of control, combined with strength and rigidity, instills into the fighter pilot that feeling of confidence under all conditions which is so essential a part of his make-up. The cockpit is roomy and comfortable and the additional equipment necessitated by the adaption of the type for different purposes can be housed without in any way incommoding either the pilot or the operational functions of the machine.

The Hawker *Hurricane* may be described as a typical example of the process of evolution of a fighter airplane. The adaptations which have been made to meet the varying needs of the fighting services have in every instance been real jobs of work, specially designed and produced to fulfill specific requirements. The fact that the *Hurricane* is still one of the most formidable machines in service constitutes a tribute to the original design and to the care which has fostered and nurtured its development.

END

Air Force on File

(*Continued from page* 102)

thumbprint, but also a record of all the steps taken to notify his family if he dies on duty, what disposal is made of his belongings and what pensions are due to his dependents.

When the recruit fills in numerous papers with questions on his civilian accomplishments and history, these with a copy of the interview with the personnel selection officer at the recruiting station are sent to the records branch. There they are filed in a folder and the file is manufactured on the assembly-line method, with one girl folding the heavy file folder, another typing on the name and number, another assembling the papers and fastening them in the file, another making out a history sheet or basic record card, other girls making out an inquiry card with all the data for quick reference, an alphabetical card file with his number for cross reference purposes and various other data being compiled in the file until it is complete.

Then, after checking with the attestation paper and supporting documents, the file is split in a number of ways, the file proper going to the filing room, the history sheet going to a room where from then onward it will be maintained up to date, the two cards going to various rooms—one to the file room and the other to a special room where girls on rotating card files keep records up to date. From all these records special tabulating cards are punched, one for each man, with code signals for each bit of information. Electric sorting and tabulating machines can give any information wanted about any number of airmen in the RCAF. Thus, if it is necessary to find how many radio mechanics are stationed in any one section of Canada, as an example, it is but necessary to put the cards through the sorting machines which can at the same time divide the group wanted into age or rank divisions, or whatever specific information may be needed.

During the night hours the RCAF base post office uses the rotating inquiry cards to re-address mail reaching the records branch for airmen trainees from all parts of the British Commonwealth. Sixty bags of mail and parcels for these airmen training on North America is an average per week, and each of the items must be addressed to the proper station where the airman is located. This is one use for the records. The high degree of speed made possible with this system eliminates bottlenecks of mail held up because of slow file checking.

Airmen move about a great deal and hundreds of times daily the records branch is appealed to by parents, relatives and friends for the airman's location. Or family illness may require urgent communication with an RCAF man whose whereabouts the family does not know. Or again, lawyers with money for or trying to collect money from airmen ask the records branch for an airman's latest address. Mail for airmen missing in operations, prisoners of war, or killed in action, must be properly disposed of, and when no return address is located on the letter, must find its way to the nearest relative, another use for the records system.

Each man and woman entering the air service is photographed and fingerprinted. Fingerprints are important in locating men who may lose their identity disks or other means of identification. From the photograph and fingerprint an identification card is made, with name, number, home address and other information. This is photographed for each RCAF man and woman.

The records branch also has a casualty section where teletype advices of those killed in training or action come in 24 hours a day. This section must properly check the incoming report with the file, must notify the family, give out press releases, see that proper papers are sent to the family and check on all financial matters. It is for this purpose that a number of lawyers are wearing RCAF uniform.

Keeping records of an ever-expanding air force up-to-the-minute is a big and complicated task, essential to modern streamlined war. The RCAF personnel in charge of records have gleaned ideas from many sources, have improved on systems in use elsewhere and now have in operation a system unique among military records.

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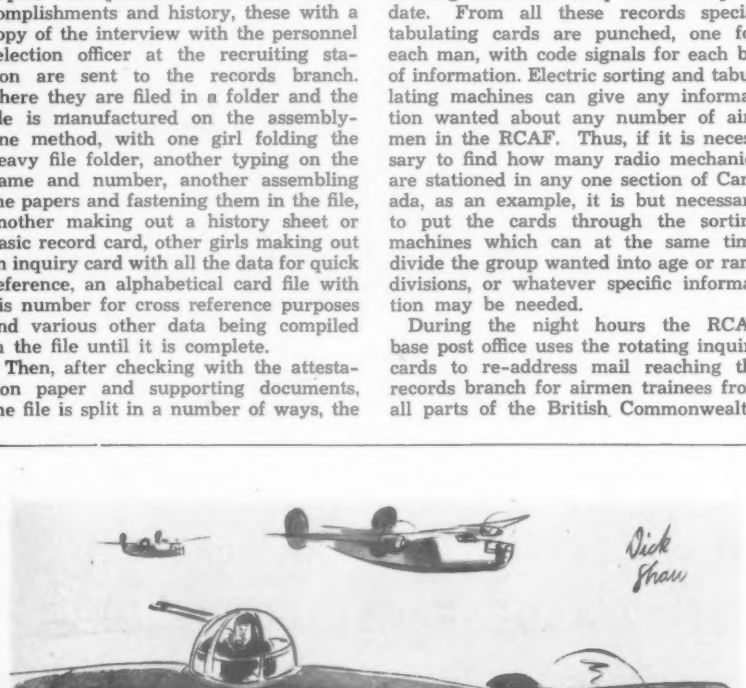

FLYING

"Thank you for your trouble, captain. My headache is gone now."

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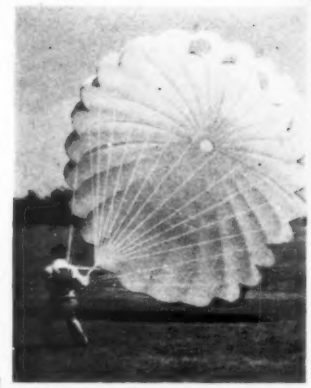

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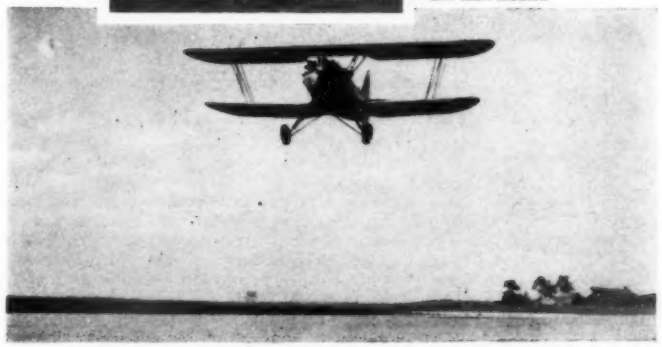

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CONTRACTORS TO THE UNITED STATES GOVERNMENT

Landplane or Flying Boat for Cargo?

(*Continued from page 21*)

the same, although it must be confessed that, due to the corrosive effects of water, more careful inspections must be made and, under certain conditions, replacements might be more frequent than on the landplane.

From the foregoing, it is apparent that if exceptionally high speeds are not desired and cargo is of light weight and large volume, the flying boat can be used for shorter ranges without penalty. To further illustrate, it can be pointed out that in studies we have made of the use of military landplanes for troop carriers, we have learned the necessity, in order to carry a large number of troops for short ranges, to figure on increasing the size of the fuselage. On the other hand, when converting a commercial carrier to a troop transport, or converting a flying boat, this naturally is not necessary. To carry this still further, for numerous long-range operations in which *Liberators* are now used, the comparatively small fuselage is not a handicap but an advantage. Because of the large amount of fuel which must be carried, the fuselage is adequate. No more cargo could be carried, due to fuel weight, even were the fuselage larger.

Another factor to be considered in connection with operations is the terrain. Still another is weather. Both have to do with the landing of either type of plane. For instance, a landplane can operate in extremely cold climates if adequate machinery is installed to clean runways of snow, whereas flying boats require ice-free waters. This often penalizes the flying boat by requiring it to take longer routes to avoid ice in landing. As most of the world's commerce is between countries which have freezing winter weather, flying boat operation is not suitable at this period. On the other hand, if machinery is not available to clear runways for the landplane, it would have to take the longer route.

The flying boat has the advantage of being able to land without the need of prepared airports. Yet, at the same time, it is more difficult to land passengers and freight from a flying boat. Obviously, in such a case, the operator must weigh the slight additional cost of construction and operation of the flying boat against the cost of runway installations. For example, in carrying cargo to small Pacific islands, where costs of field construction would be prohibitive or construction virtually impossible because of mountainous terrain, the flying boat would have inestimable value. Another outstanding point in connection with the flying boat is that it can and has landed at sea upon many occasions to pick up survivors of sea and air disasters. An outstanding case in point, of recent date, is the rescue of Capt. Eddie Rickenbacker and members of his crew. Prior to the war, the Coast Guard proved this again and again.

Many persons, not only laymen but pilots and engineers as well, overlook another point which redounds to the favor of the boat flying over land. A survey of inland waterways in the United States reveals that there are just about as many lakes, rivers, reservoirs and other bodies of water suitable for the landing of the largest flying boats as there are airports suitable for the landing of military landplanes.

In South America, where the rivers and lakes are far more numerous than suitable landing fields, it probably soon will be proved that flying boats can be extremely useful in bringing out huge cargoes of materials needed in our war effort. Obviously such an operation, from the standpoints of financial and time economy, would be far more practical than attempting to build landing fields in jungles.

There have been questions raised about the practicability of the hull in the case of landings, either forced or deliberate, on rough waters. Experienced flying boat pilots report that the greatest hazard encountered is in the initial contact of the boat as it lands on the water. If this is accomplished successfully, the flying boat will ride out just about any kind of storm. Again and again, flying boats have ridden for days, through all sorts of weather, to eventually drift to land, or to allow passengers and pilots to be picked up.

In connection with the use of landplanes in the Pacific at the present time, I am reliably informed that airports of adequate size to accommodate such high performing landplanes as the Consolidated *Liberators* are available in practically all general areas of operation. These airport provisions therefore permit the use of the more efficient long-distance landplanes to such points, but make necessary the use of other short-range ships which can stop at other points not equipped with adequate airport facilities. For this purpose the flying boat is of inestimable value.

So we return to my original premise—that operational circumstances govern the choice of landplanes or flying boats. There is little use in comparing the planes *as* planes, but only in relation to the job they are going to be called upon to do. In a task where high speed (the result of high aerodynamic efficiency) is essential, and where suitable airports are available, I think it is safe to favor the landplane. On the other hand, when very high speed is not essential, and where there are no suitable airports, I think the flying boat can do the better job.

END

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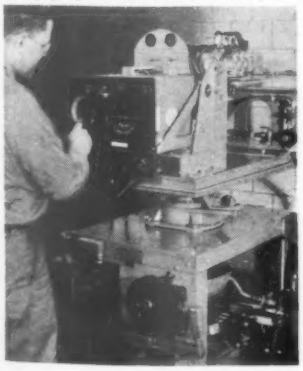

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Constellation

(Continued from page 35)

When Eddie Allen, after one test run, hauled the tricycle-geared, triple-tailed giant from Burbank's east-west runway, the five men inside were probably cheering as loudly as the crowd on the field. Milo Burcham, who did most of the testing of the P-38 *Lightning*, was busy in the co-pilot's seat, although he didn't have the usual job of getting the wheels up. They were left down for the entire first flight. Back in the cabin were C. L. "Kelly" Johnson, Lockheed's chief research engineer; Rudy Thoren, Johnson's assistant in solving the many test flying problems; and Dick Stanton, chief mechanic who knows every working part and control of the big ship and how to fix them if necessary. Circling the San Fernando valley twice, the ship headed north over the mountains for the Army's air base on Muroc dry lake in the California desert.

The Army, for reasons of military security, isn't quoting any exact statistics on the *Constellation*, but some features of the large craft were released to newsmen at the moment she took to the air for the first time. The *Constellation* will do much of its flying at 20,000 feet, above the worst of the weather, while its pressurized cabin maintains a supercharged atmosphere equal to the 8,000-foot level. In case of the need, the ceiling can be boosted easily to 35,000 feet.

Partial engine failure is no particular problem. The new Lockheed will maintain a 25,000-foot altitude on three of its engines and will fly at 15,000 with only two. Its range, speed and reliability will enable it to blaze new travel routes and extend the limits of logistics and military supply. Hall L. Hibbard, Lockheed vice-president and chief engineer, can well be proud of the ship which he and his staff have designed and built. They'll tell you frankly that its performance stems from the research done on the P-38. The *Constellation* wing is a perfect enlargement of the one on the *Lightning*, the world's fastest military airplane and, as late dispatches prove, one of the most deadly fighters. Built originally for airline work, the *Constellation* embodies more safety features than any other airplane, and these will prove their value when the big ship goes to war. The Army has given permission to tell about these new features:

Stainless steel engine nacelles and cowlings, within which a fire would be confined for 30 minutes without interrupting flight or causing serious damage.

Automatic fire-control system with 16 thermostatic couplings in each nacelle, advising the flight engineer instantly and precisely where to operate his remote-control fire extinguishers.

Dual brakes on the dual wheels of the landing gear, practically eliminating the possibility of brake failure.

The "hot wing" de-icer as developed by Lockheed, using engine exhaust instead of pulsating de-icing boots.

Hydraulic boosters on all controls for the first time, eliminating pilot fatigue because he exerts only a small fraction of the effort required to move the control surfaces.

Short take-off and landing runs and unique maneuverability at slow speeds, due to the double-acting Fowler flaps.

Pressurized cabin with two separate superchargers, either of which will maintain correct air density.

Reserve range for flying around severe storm conditions.

Triple tail, giving better control especially after partial engine failure by placing control surfaces directly behind rather than between the engines.

Passageway in wing, permitting the engineer to reach all engines in flight.

As an air luxury liner, the *Constellation* could be equipped to seat 60 passengers in lazy comfort in addition to a flight crew of five and the service attendants, but climbing over the California hills in Army camouflage it doesn't look like a luxury ship. It's big, it's fast as the very devil, and it looks ready to go anywhere our fighting men need it. We who have seen it fly know that it's an excellent airplane, and even the modest and conservative "Bob" Gross, president of Lockheed, admits it's good.

"I believe this airplane is the greatest contribution to air transit yet made by Lockheed," says Gross. "It is designed and built to do a necessary job as well as it can be done today, happily timed for the war cargo emergency which confronts us, and for the reconstruction to follow the victory we must first win."

END

FLYING

Two New Japs

(Continued from page 64)

Some of the high speed and high altitude characteristics of the reconnaissance version of the I-45 were lost when the weight of guns and ammunition was added in its conversion to a fighter—the Japs, said Hill, "had to sacrifice an awful lot in performance." The I-45 fighter, he explained, had three cannon in the nose, another 20 mm. cannon firing to the rear, and possibly some machine guns.

An attempt to give their pilots at least the protection of self-sealing fuel tanks was indicated by the discovery of new types of containers on the Jap planes. Actually, however, these fall short of their purpose, Hill reported, because the tanks definitely do not seal the puncture of a bullet, but tear and shatter, and the planes "are always catching on fire."

Moreover, armor protection for the pilots still apparently is considered an unnecessary luxury by the Japs—Hill reported that "even the I-45's come apart in the air when we hit 'em."

END

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It Takes Sense to Fly

(Continued from page 58)

that will cause instantaneous reaction.

Good hearing sense can be developed by actually stalling the plane and listening intently to what is happening. Conscious application of the use of all the five senses will soon bring results; in other words, we must use a sense in order to keep it sharpened.

The third sense is the old, familiar *feel of the controls*, without which good, smooth flying is difficult and safe flying is well nigh impossible. (Don't confuse it with seat-of-the-pants flying, however, which is sense number four.) Most lightplane pilots know how delicately one must feel the controls in order to fly well. Everyone has heard the advice "Fly the plane, don't let it fly you," and yet many pilots think that means to be brutally forceful.

Nothing could be more incorrect. *Feel* of the controls is best explained in steep turns and landings, but before trying either maneuver we must hold the controls correctly. Grasp the stick lightly and with the fingertips—not as you'd hold a baseball bat; press the rudders with the toes or balls of the feet, not the insteps and press only one foot at a time (the best way is to press on one foot, raise back on the other).

Now enter a steep turn. By grasping the stick lightly a pilot can *feel* what goes on, just as you weigh a light object by holding it lightly instead of grasping it with a clenched fist. Notice as you increase the bank that more stick pressures are necessary, mostly back pressures. Remember that, and next time when you're in a steep turn close to the ground you'll recall that excess pressure is your cue that the plane is being flown near its limitations of maneuverability.

The feel of the controls is a sense very useful in landings. It must be used in co-ordination with vision, but no pilot can consistently make good landings if he does not feel the plane down. The pressures required can be estimated only by light, tentative movements, and as the plane begins to stall the fingertips will tell a pilot when to ease back fully.

"Feel of the controls" has become a common term ever since the use of the modern method of teaching *control pressures* instead of *control movements*. As a matter of fact, one should forget the controls and fly the airplane, but such a doctrine is hard to put across unless we tell a student how to go about it. Cultivating good sense of the controls is indispensable; a pilot who doesn't get an impression of his plane's attitude or limitations by feeling the stick pressures is a pilot not to fly with!

Finally we come to the fourth sense, called by many an old-timer as "flying by the seat-of-the-pants." It means literally that—flying by the way one sits. Some pilots have gone a step farther and stated that we do the actual feeling with the muscles deep inside: in other words, kinesthesia, which is simply defined as muscle sense, and is a bit more high flown. The point is, you *can* fly better by flying with the deep muscles and by recognizing the message they have to tell.

The ability to use this sense of feel is the difference between the finished pilot and the planeherder. The pilot who has cultivated his deep-muscle sense can tell instantly when he's skidding or slipping, within a degree or so as shown on the bank indicator. (That means no more displacement than one edge of the ball just outside the cage!)

FLYING

"Y'know, captain, I think we've got a *real* flyer there . . ."

Let's go back to the example of a steep turn. So many, many reports of spins from steep turns indicate that the senses of feel were literally ignored! If a pilot is truly alert and responding properly to the warnings from the important senses just described, he can't possibly be caught in such a predicament.

In order to test yourself, obtain an inexpensive bank indicator (steel ball in a glass tube) and mount it in the plane. Paste a flap of paper above the device and allow it to overhang and obscure the ball. In all your flying, never devote your attention to the ball—merely check yourself with it. This also applies to the steep turn. As you fly, feel with those deep muscles, the intestines, and the seat of the pants. Try to judge whether you're leaning to the bottom, being thrown to the top, or sitting squarely in the center. When you think you're in the center, raise the paper flap and glance at the ball. It should be on zero, or centered; if it is not, your judgment was wrong and should be improved until you can estimate the position of the ball accurately every time.

Obviously, continuous practice is required before one can do this well, but that merely means being alert at all times and being conscious of the signals that the four senses are sending to your brain. Sense four is valuable not only in turns but in general flying, in stalls, in glides and in landings. Notice how quickly you can react to changes in attitudes, motions or speeds! After a while, the kinesthetic sense will become the most reliable and valuable flying sense you possess.

The best hint for the use of sense four is relaxation. In order to feel objects we hold them lightly, and in order to feel with our muscles we must relax them. In landings if the deep muscles are untensed, a smoother, better technique will evolve because it is possible to feel the plane and estimate more accurately when that last bit of flying speed is dissipated.

The four senses just described are physical ones, tangible and obvious. The last sense in the list is often referred to as "horse-sense," common sense or just plain sense. Unfortunately, most of the accidents today are listed under pilot error and pilot technique resulting from poor headwork. How can one possibly improve his fifth sense—headwork?

The answer is: by learning from experience and constant self-analyzation. It has been said that the poor pilot who knows his limitations is a safer flyer than the "ace" who does not. So learn what you can or cannot do—and don't try to do more.

An example of this (with a happy ending) was brought out in the following story: A pilot en route to Atlanta from Washington read his forecast: "Contact within two hours." He took off and noticed that over Richmond he was still in soupy weather, which at Greensboro became solid. Why not push on for Atlanta, in view of the favorable forecast? It seemed logical enough — but something warned him to *check*. Something in that *fifth* factor—horse sense.

Sitting down at Greensboro, he found that the stuff had closed in tight at Atlanta, with visibility of one-half mile and ceiling of 400 feet! To have pushed on would have meant a sure crack-up, while, as it turned out, a short wait on the ground allowed his destination to become contact. The trip was concluded

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safely and, except for having his wheels and flaps stick at Atlanta, uneventfully.

Sense five has also been described as intuition; pilots on their final approach for a landing have been "warned" to move the nose and look—only to find a plane in their path. That isn't intuition—it's good sense. It means being alert, looking out for the unexpected, and anticipating that bit of so-called bad luck that the superstitious call breaks. Such things don't happen to pilots who use common sense as often as they happen to pilots who don't use it—or who don't possess it.

A good way of checking one's judgment is to analyze the decisions that have been made, or to study the accidents that have occurred. Do you do such things as mapping alternate routes, keeping track of nearby landing fields on cross-country flights, checking oil and fuel constantly, and so on? Have you imprudently pushed on in the face of bad weather or approaching nightfall? The list is endless—but it will indicate how much good old-fashioned horse sense you possess.

It is obvious that, even by continuous use of the first four senses, a pilot is not reliable until he is on speaking terms with common sense. Yet common sense will not make a pilot, either—it takes the entire five to win that flattering comment from the hangar group: "He's a good pilot!"

END

The Wrights Were Right

(*Continued from page 40*)

Smithsonian Scientific Series, Vol. 12, page 227:

> The flights of the Langley aerodrome at Hammondsport in 1914, having been made long after flying had become a common art, and with changes of the machine indicated by Dr. Wright's comparison as given above, did not warrant the statements published by the Smithsonian Institution that these tests proved that the large Langley machine of 1903 was capable of sustained flight carrying a man.

"6. If the publication of this paper should clear the way for Dr. Wright to bring back to America the Kitty Hawk machine to which all the world awards first place, it will be a source of profound and enduring gratification to his countrymen everywhere. Should he decide to deposit the plane in the United States National Museum, it would be given the highest place of honor, which is its due."

Except for Dr. Wright's list of 35 specific differences between the Langley machine of 1903, and the Curtiss reconstruction of 1914, this is virtually the complete text of Dr. Abbot's booklet.

These changes listed by Dr. Wright are of interest principally to aeronautical engineers, but some very important ones deserve general notice, since competent engineers have described them as being of "vital" importance in the structure of Langley's aerodrome.

One was the location of the guy posts which braced the wings. The wings collapsed in both attempts to launch the machine in 1903, and engineers have held that this collapse was due, not to the general wreckage created by failure of the catapult, but to the fact that Langley had no information concerning the center of pressure on cambered wings and placed the guy posts too far forward. In 1914, Curtiss and Dr. Albert F. Zahm strengthened the machine by moving the guy posts back.

The camber of the wings was changed to reduce the drag by about 30 per cent, and the covering fabric was varnished. The spars and ribs were strengthened considerably and Curtiss added the Wright system of lateral control to the Langley machine.

The original Wright machine now rests in South Kensington, England, and probably will remain there until after the war. When it comes back from England—if it does—Dr. Wright will have another, but lesser, controversy to settle. The Smithsonian would like to have it, but North Carolina wants it placed in a museum at the base of the Kill Devil monument which marks the site of its first flight at Kitty Hawk.

END

Air Traffic to Come

(*Continued from page 45*)

into the ultra high frequency band. Automatic airway traffic control boards, such as that installed in the Washington National Airport, will eventually replace all manually operated boards by which the movements of planes along the airways are followed.

These are practical certainties. It is among the uncertainties that the more interesting prospects are found. One of these is the matter of instruments by which pilots in the air will be warned of the proximity of other planes, and thus relieve the man on the ground of one of his biggest jobs. Such an instrument now in development is called a "vertical separation indicator" in the contract under which a private firm is developing it in collaboration with the CAA. The war has interrupted this development, but it is hoped that this (or a similar or better instrument) will evolve in this all important field.

What the CAA traffic men want to accomplish by such an instrument is to keep the pilot informed of the position of other planes in the air near him. In its ideal form, it would tell the pilot what other planes are in the air within a radius of 10 miles of his plane, at what altitude they are and in what direction. Thus the airway and airport traffic controllers would be relieved of the exacting job of keeping several distant pilots informed of traffic presumed to be close to them. While they can do this today with reasonable safety and accuracy, they admit there are elements of danger

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involved and that the expected increase in flying will probably make today's methods impossible.

A good example of the value of such an instrument is found in the "stacking up" process now followed in landing several planes at close intervals in conditions of bad visibility. Arriving planes are assigned various levels by the man in the tower, and they circle there until the lowest plane can safely come in and land, working out the approach procedure required for that airport. Then the tower man verbally instructs each of the other planes to drop down to a lower level, and the new low man comes in. Equipped with an automatic separation device, all pilots would be constantly informed of the position of all other planes and could govern their landings accordingly.

This landing procedure is closely tied in with airport design and size. CAA traffic men have their own vision of the ideal airport, and it is one that will accommodate aircraft landing at intervals of 30 seconds, and aircraft taking off every 30 seconds under instrument conditions. Thus 240 movements an hour might be possible even in bad weather conditions, which contrasts with 15 or 20 now considered safe and possible under bad weather conditions and present methods.

Such an airport would have parallel runways, completely unobstructed loading ramps, the shortest possible taxiing strips, an underground approach for vehicular traffic and should be designed to allow for expansions to meet future needs without sacrificing its important features.

Instrument landing can no longer be considered an uncertainty, because some 100 such installations are now under way, at least in part. When the war is over and the third element—the glide path—of each of these systems is installed, a respectable part and eventually all major stops on the whole airways system will be so equipped.

A device would be installed in the airport tower, larger and more informative, to automatically give the traffic controller information on the whereabouts of the planes he is handling.

The automatic system for handling flight data is no longer an uncertainty. Gradually, this system will replace those now in use where controllers move slips of paper to indicate the changing positions of planes in their areas. With the automatic board, the essential information on a given plane, once established, can be transmitted automatically to various points where that information is necessary for safe control—another case in which man has produced a machine to relieve his hands and his mind of details.

At Washington, the automatic board and the manually-operated b o a r d are working side by side in a sort of operational test, while the traffic controllers study and plan for the air age ahead. The automatic system has a greater capacity than the manually operated and cuts down materially the time between the pilot's report and the posting of the information. It also gives the personnel of the station a warning signal of hazardous or potentially hazardous aerial traffic situations. The data it carries can be posted simultaneously in several places, including remote stations such as control towers. Extension of this system to the east coast will probably take another two years, and three to five years for the entire country.

Radio ranges all will be of the ultra-high frequency type, but not all of the intermediate frequency stations will be eliminated. Some will probably be left for use in radio compass flying. Airline planes will probably use the dual automatic radio compass recently developed by the CAA, and smaller and less expensive homing compasses are expected for use in the smaller private planes.

Two voice channels will be installed on the ultra-high frequency ranges, CAA men expect. One will be used for traffic control communications and the other for meteorological and other messages. Other facilities, including interphone and teletype systems, must be expanded materially if the new volume of traffic is to be directed safely.

The experts envision heavy increase of contact flying, and are already planning segregation of local traffic from through airway traffic. In fact, they see long hops between cities routed along great circle courses, with the various kinds of local flying stratified and zoned along the airways and at terminals.

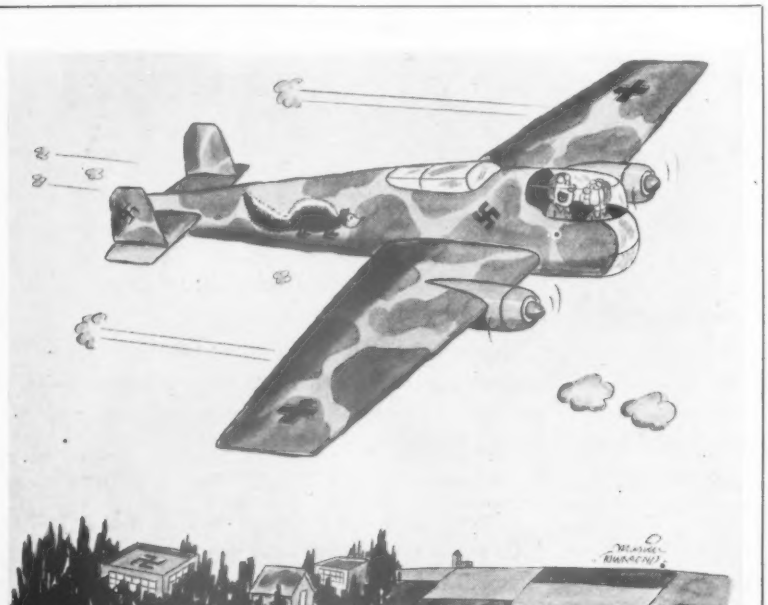
In all of these plans for the future, the CAA is moved by two principal considerations: (1) to restrict as little as possible the operation of aircraft in weather conditions in which pilots can see and be seen sufficiently to avoid collision; and (2) to control aircraft operating in bad weather conditions so that frequency of operation and volume of traffic can approach as closely as possible that under unrestricted weather conditions.

To accomplish No. 1, four things must be done: the pilot must observe the simple "rules of the road" when flying along Federal airways; air traffic must be zoned according to type of operation and perhaps according to the speed of the aircraft; traffic patterns must be established at airports where traffic is light; and traffic towers, equipped with the latest in equipment and methods, must be operated at busy airports.

To accomplish No. 2—that is, to make possible 100 per cent regularity in flying regardless of weather—automatic flight data communication and posting systems must be installed; airports must be equipped for instrument landing; and automatic separation devices for aircraft must be developed.

"We are looking forward confidently to the day when we will be flying in free air again," Charles I. Stanton, CAA Administrator, said in discussing the report of the Air Traffic Control Division of the Federal Airways. "We will never be free of traffic rules, of course, but we expect the time is not too far off when civil aircraft will be able to fly again where and when they please. A minimum of regulation consistent with safety, and a maximum of the best flying aids available—that's the job before the CAA—and we are working as hard to prepare for it as we can under the present condition of high pressure in which we are doing all our work."

END



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Report from Washington

(*Continued from page 44*)

small losses, though it must be assumed that the Axis will find some method of again equalizing this situation. Lockheed's *Lightning* (P-38) seems to be justifying in actual combat the high opinion held for it by the writer in published comments almost a year back. Both in North Africa and in the South Pacific the *Lightning*, once described as a "hot" ship with an incurable tail flutter, has proved itself vastly superior to the Jap Zero and on the record a finer piece of combat mechanism than either the Focke-Wulf Fw-190 or the Messerschmitt Me-109G.

Republic's *Thunderbolt* (P-47), now in production, and for which high hopes are held, is said to have made contact with the enemy in an experimental encounter in North Africa and to have more than justified the expectations held for it. Much is expected of the Bell *Airacobra* (P-39), in production in a radically altered design, and the fast North American *Mustang* (P-51). In quantity these will be relied on to take over the routine sky slugging for the Air Forces.

Plastics and plywood are coming into heavy use. The McDonnell Aircraft Corporation has announced the use of a laminated paper plastic as a substitute for aluminum. Both Ryan and Fairchild have completed plastic-bonded jobs for the Army which practically eliminate critical materials. In the Ryan plane, a primary trainer, substitutes have been made for all strategic metals with the exception of the engine cowling. Other companies are eliminating aluminum by the use of wood or thin sheet steel.

The extraction of aluminum and magnesium themselves has been vastly accelerated. Production on the former alone is said to have exceeded one billion pounds during the year, and to be rising rapidly.

A great deal of attention is being centered on air cargo, on which a spectacular expansion is looked for. The Fairchild company has announced the development of a long-range tank carrying plane which is now in production. Consolidated Aircraft Corporation has drawn plans for a huge transport capable of carrying 400 passengers at 500 miles an hour to Europe and back without refueling. The Curtiss-Wright *Caravan* (C-76), to be built with 65 per cent of the work subcontracted to the wood industry, also is capable of carrying a battle tank and is said to have a range in excess of 3,500 miles. Among others, the shipbuilder Andrew Higgins has an order for 1,200 Army cargo planes *(Caravans)* to be built largely of non-strategic materials. First deliveries of these huge craft are planned by early summer.

Cargo carriers now are rolling off the production lines of many companies in quantity. It is believed that the existence of these facilities will completely revolutionize all transportation for the post-war period. Present figures indicate that the cost of air-carried freight can be brought to less than four cents per ton-mile. At this figure the economic factor overwhelmingly would favor the air carrier for all first class travel, shipments of perishables, or goods in which the time factor entered.

That there will be an international race for control of the air lanes after the war cannot be seriously doubted. With an eye to this development Croil Hunter, president of Northwest Airlines recently issued a statement urging that the principle of *Freedom of the Air* be adopted as a corollary to the *Freedom of the Sea* principle. He asserted that this would be "a great boon to the war program and the peace to follow."

There is complete certainty here that air installations and production facilities will not be allowed to decay as after World War I. Glenn L. Martin looks for a demand for commercial planes in quantities so huge as to be "bigger than anything we ever dreamed of." The signs of the times are written in the deep interest evidenced by the Congress. In the House, Minority Leader Joe Martin joined the movement for the establishment of a standing Committee on Civil Aviation, asserting that "we believe that while we concentrate on our war aviation needs we must also plan the place America must occupy in air transportation in the post-war world." He seeks a continuing committee to deal with aviation problems and development.

The best opinion here is that there will be inevitably a Secretary for Aviation in the President's Cabinet as soon as the improvisations due to insistent war problems have lost their usefulness. The mushrooming post-war industry will touch every angle of American life, social and economic as well as political and military. It will require some type of control in the best interests of the nation.

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Washington, D. C.

END

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Air Insurance

(*Continued from page 70*)

tion will normally be made on the date which the certificate is received by the insurance underwriters—not the date when it is received by an agent.

All such insurance certificates expired concurrently with the joint or master policy on September 2, 1942. No pilot will be allowed to operate an aircraft under Civil Air Patrol operations orders unless he is in possession of a valid certificate, according to the ruling made by Civil Air Patrol headquarters.

All Civil Air Patrol pilots, or those contemplating qualifying as such, should get in touch with a qualified insurance agent who is experienced in writing aviation insurance. An agent representing either Aero Underwriters, Association Aviation Underwriters, U.S. Aviation Underwriters or Newhouse, who handles the aviation writings of the Employers Group, must prepare the certificates for the pilot. It is important that the agent follows his instructions closely because the certificate must be properly filled in or it will not be validated by the insurer. On the certificate must appear the pilot's first name, middle initial and last name; the name of the wing commander together with his *headquarters address;* the date and the amount of the premium; the agent's name and *complete address.* The pilot should be sure that the agent signs the receipt and delivers it to him

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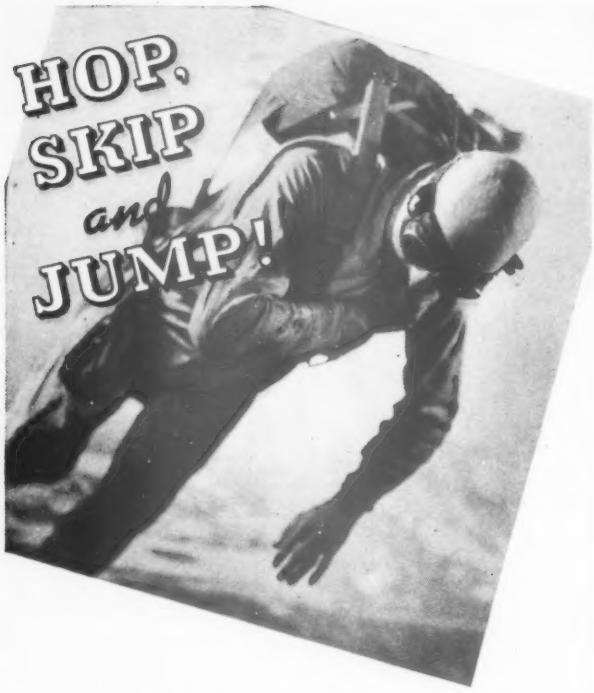

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after the premium payment has been made. It is important that the pilot retain the receipt even though such receipt does not constitute a binder as in the case of regular fire or automobile insurance.

After the application is completed, the validated certificate will be sent to the pilot *direct from the underwriter* and not from the agent who handled the transaction. At the same time a copy of the certificate is filed with the Civil Air Patrol headquarters in Washington.

These required policies are issued only on a six-month term basis or less. Policies issued at the start of the six-month term (March 2) carried a premium of $12.50. Policies becoming effective during July call for a premium of $7 and those becoming effective during August call for a premium of $5. New master policies, covering another six-month period, were filed on September 2 when the present policies expired.

As in the case of the War Training Service insurance, the public liability coverage is $50,000/$100,000, but the property damage coverage is increased to $50,000 in the case of the Civil Air Patrol.

In the usual aircraft liability policy there appears what is known as a war risk exclusion. This standard exclusion has been amended in the new Civil Air Patrol master policies and now reads as follows:

"This policy does not cover any liability in respect of bodily injuries (or death resulting therefrom) or in respect of damages to or destruction of property resulting from or arising in consequence of: (1) the act of any enemy of the United States; (2) the approved aircraft or its occupants being shot at or bombed by any persons whatsoever; (3) the participation of the approved aircraft or its occupants in actual hostilities; (4) insurrection, strike, riot or civil war."

END

Service for Tomorrow

(*Continued from page* 88)

the LeMars field, and two at Sheldon, 37 miles way.

"I would have to let two instructors go, but that's all," he says. "Looking over our list of commercial students, you'll find that 125 fly with us from time to time and that 25 are steady customers. If the war stopped, we'd have more private students. And in addition, we would have the business of the pilots from this area who, on returning from active service, will want to keep their hand in.

"I sincerely believe that the adequately equipped operator has nothing to fear from war's end, and that he will find himself in a period of prosperity. But only if he is ready and willing to give service. The days of sitting on an oil barrel and whittling while planes go by to other airports for better service are over."

DuVon, flying his Interstate much as an average man used to drive his car before the tire shortage, is constantly making trips to Omaha, Kansas City, Des Moines, and other cities. These are mostly business trips today. When he flew prior to December 7 of last year he covered much greater territory.

"And service conditions were terrible," he says. "I went into one city of nearly half a million population, asked for a 100-hour check, went into town. When I came back, I found a lad of about 15 years peering into the windows of my plane. He looked like a sightseer. I asked him what he was doing. 'I'm giving your ship a 100-hour check,' he replied, nonchalantly. I took off my coat, went to work and did the job myself.

"I've travelled through as many as three states looking for someone to check my plane, or to have some small repair made. Conditions like this cannot continue if we hope to push private flying over the hump."

DuVon issues a final word of warning to fellow operators who aren't getting ready for the big push. During the World War, there were 23,000 airplanes manufactured—some say as many as 27,000. In 1936, there were about 8,000 registered airplanes in the United States. There were about 23,000 pilots trained during the last World War. In the middle

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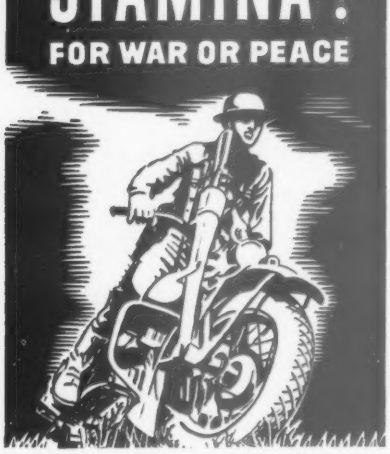

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twenties there were not more than 2,000 pilots actually engaged in flying, either commercially or privately.

"The same thing can happen this time," he concludes, "if we don't wake up, stand on our own feet, go after business and give service. In the good old days, the flying fraternity was small, everyone knew everybody else, and the visiting pilot was treated like a king. This small fraternity has broken up, there are and will be hundreds of thousands flying, we hope. The personal touch of the twenties will be gone forever. But, while sentiment has gone out of our craft to a certain extent, and the spirit of fraternity has been weakened, we can't be commonplace about our treatment of fellow-flyers. We've got to show common courtesy. If we don't we won't even be able to compete with the roadside filling station."

END

Helicopters

(*Continued from page 38*)

copter is able to ease down immediately in front of a field commander's headquarters. Other uses as in the role of an aerial ambulance, for example, are likewise suggested.

The Army turned its attention to the helicopter when Sikorsky kept his pioneer machine aloft for an hour and a half in April, 1941, hovering like a humming bird over an area no greater than a half acre. The Air Forces only recently had made exhaustive field tests with Kellett autogiros, employing them for various purposes in the 1940 Louisiana summer maneuvers. This test resulted in a decision that for the time being the autogiro's advantages were insufficient to justify its use in place of existing standard airplane equipment.

Nevertheless, experiments with the autogiro have been continued by the Army and other Government departments, such as Agriculture, the Forest Service of the Interior Department, and the Post Office. From these departments a body of experience with rotor plane operation has been built up which should pay future dividends.

To man the autogiros under test, the Air Forces operated a special training school for pilots. Those who have had this training and experience now are guiding the new helicopter project.

It is believed there will be no difficulty in schooling pilots to fly a heavier-than-air craft with both the lifting and propulsive power supplied by a rotor instead of a propeller and wings or propeller and rotor. One pilot with previous rotor plane experience soloed the Sikorsky after an hour and a half dual flying and, it is calculated, the average pilot without prior specialized experience could acquire the skill in some five hours.

The Army's concern with the helicopter is naturally in its possible adaptation to war, but AAF airmen involved in the development project share some of the keen enthusiasm of Sikorsky himself, who is on record with a prediction that 10 years after the end of the war the manufacture, sale and maintenance of helicopters will have grown to become a billion-dollar industry.

The extravagant predictions made for the autogiro a decade ago will tend however to temper the enthusiasm for the future of the helicopter until its development has reached a more advanced stage. The autogiro was introduced to the commercial and private market in the United States in 1931, loudly hailed as the final answer to the dream of safe and useful private flying. It could not live up to the public's advance expectation. The depression and the death of Juan de la Cierva, autogiro pioneer, put a damper on progress, though the Spanish inventor's revolutionary wingless type has long since been substituted for original models and a number of definite advances have been made with Army co-operation.

The rival helicopter, centuries old as an idea, pushed into the aviation foreground on the eve of the war when Heinrich Focke's twin-rotor machine made spectacular flights under perfect control in crowded auditoriums in Germany. Exceeding the performance of other pioneer helicopters, it reached an altitude of 7,500 feet, speed of 74 m.p.h. and remained aloft for one hour and 20 minutes.

Then the veteran Sikorsky went the Germans one better with his VS-300, which had a single rotor plus three auxiliary airscrews for control purposes, all driven from a 65 h.p. Franklin engine. That is when the Army's interest really became keen, and the attack started on such problems as the torque from a single rotor, methods of control, and what happens when more power and weight are added. One well-recognized weakness of rotorplanes, however, is their present decidedly limited load-carrying capacity. That deficiency is being given its full share of attention.

END

Industry Row

(*Continued from page 62*)

ments, however, is actually borne under present conditions by the taxpayers, since the cost of membership is an allowable expense against fixed-fee Government contracts.

The Chamber's fiscal year closed October 31, and the rules provided those who were members after that date were liable for assessments for another year. So with the big Los Angeles area members pulling out, most of the other leading manufacturers, with the exception of Martin, reluctantly put in resignations which they described as "technical." Some offered to pay several months in advance to meet expenses, but that was not necessary as the Chamber possessed a substantial reserve fund.

Meanwhile Colonel Jouett had removed himself from the picture by resigning to build airplanes for the A. J. Higgins Industries, of New Orleans. This action provided no solution. There was no hint the quarrel revolved about the president personally. Newton took over temporarily.

To seek a settlement, a special reorganization committee, headed by Edgar Gott of Consolidated, went to work with

representatives of Curtiss-Wright, Boeing, Douglas, North American, Lockheed and Taylorcraft, among others. There seemed to be a general agreement that the Chamber could stand some "streamlining," possibly in the direction of giving the larger companies a greater voice in determining policies. They pay the bulk of the assessments but enjoy only a single vote along with all the rest of the more than 200 manufacturer members.

Any proposed formula involved difficulties. The Southern California group, increased in relative importance by war orders, had been paying about 27 per cent of the Chamber's total assessments, which were based on total aircraft sales. As of last July, they turned out some 35 per cent of all completed aircraft. The East Coast, Mid-West and other sections accounted for the rest of the completed planes, and also 90 per cent of the instruments, and all of the engines and propellers.

Anxious bystanders from the start have been the Army, Navy and War Production Board. It was a private row, but in time of war anything to do with the aircraft industry obviously affects the nation's interest.

END

AOPA News

(*Continued from page 58*)

that this stricter military control over WTS operations will reflect itself in several ways, not the least of which will be the bunching up of quotas. In place of 10 or 20 students being trained by a WTS contractor, we believe that 100 students is a likely minimum and that operators continuing with the program will have to be in a position to furnish equipment for these larger quotas.

Biggest point in favor of increased military control is the possibility of higher priorities for parts for the WTS operators.

This is a period of rapid change. Pilots are urged to keep in close contact with the AOPA Washington Service Office so that they may plan intelligently their future aviation activities, whether dependent directly upon military training preparations or miscellaneous non-scheduled flying activities.

About the Weather

Numerous complaints have been received regarding the present manner of transmitting weather to pilots in flight with the present weather-code system. This is a touchy subject since it involves security considerations. We will make no attempt in the AOPA News to argue the case as to whether or not coding of weather forecasts is necessary or even as to whether the present restrictions are necessary. This is a matter which military authorities must weigh with consideration of the country's security on the one hand and the safety of their own pilots on the other hand.

AOPA is interested in the matter of emergency procedures, and members are urged to study the detailed discussion of this matter in the AOPA Section.

END

Carriers Coming Up!

(*Continued from page 44*)

beside the landing signal officer and sees that the planes have their hooks down to come aboard. When planes approach the landing circle, he sings out "Hook Up," if necessary, and the landing signal officer gives the conventional signal, waving the plane off, or bringing it aboard, depending upon its distance away from the flight deck.

Ground crews are as much a part of a combat aircraft squadron as the pilots themselves. They take a justifiable pride in the performance of their planes and pilots. "We got five today," said James Shinn, AMM1/c and O'Hare's engineer aboard the *Lexington*, when "Butch" made his famous killing. He's now the envy of his colleagues at the Chicago Vocational School.

The exigencies of modern warfare has completely changed life aboard a carrier. Old line Naval regulations have been tossed out of the portholes for the duration. The object is to make pilots as comfortable and as contented as possible during their rest hours. So it is aboard the *Wolverine*. As the converted lake steamer steams north up Lake Michigan under zero ceilings, pilots play cards and bandy jokes, loll on sofas and write letters home. Negro attendants keep coffee and cheese sandwiches ready at all hours and provide good, inexpensive meals. If the carrier anchors near the Chicago breakwater men are granted shore liberty overnight. These pilots are training for just one mission—to fly and fight. Red tape is slashed as much as possible to further that end.

In the Navy book, carrier duty is considered the most fascinating job in aviation. Qualification is not necessarily difficult. Orders on the *Wolverine* flight board say simply "Don't make mistakes." They are too expensive. Pilots are cautioned on take-offs not to let their planes settle when they leave the bow, since there are just 26 feet from deck to water line and, with a heavy sea rolling, it is imperative to hold the plane's altitude when leaving the deck. They are given simple instructions such as turning to starboard as soon as possible on take-offs and not flying across the bow during a wave-off as other planes may be taking off. Soon, such operations become routine to them.

The safety record confirms this. "There hasn't been a single serious accident since I've been aboard," said Captain Bowman. He looked down the flight deck, spotted with ice from a raging January storm. "If they can qualify here, they'll be all right anywhere."

END

Texas Storm Defeated

ABRANIFF Airways plane's radio kept Amarillo, Tex., in touch with the outside world when an ice storm broke down all wire communications. Conventional radio transmitters were put out of action when power lines collapsed.

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At Deadline

(*Continued from page* 14)

TALKING with a friend the other day —a man in the aircraft manufacturing industry—he told us some of the ideas his company has for private or sport plane designs after the war. Because we were talking about the vast air-minded public that will be flying, we disagreed with that manufacturer's conception of the private plane of the future. Like almost every other old-time manufacturer in the industry with whom we've had contact, he was speaking in terms of the pilot as we have known him all these years. His version of "the" private airplane was one that could get 150 m.p.h. cruising out of a 100 h.p. engine, one that was a little more comfortable inside, could carry three or four people and have fairly long range. Period. In other words, he is sure the air-minded public after the war wants an airplane basically identical with those flying today, with a few modifications, most of them having to do with speed and range.

We always have felt that the air-minded man-on-the-street doesn't care a darn whether the private plane of the future cruises at 150 or 110. He'll buy the 110 just as quickly as the 150—so long as he gets the other things he wants. The speeds to which all pilots are accustomed today mean little to the average man. Even if he could average a mere 100 m.p.h., he would be doing at least 100 per cent better than he ever could in his car. Primarily, he wants safety, safety —and more safety. Then comes ease of operation, utility, economy and comfort. He wants to know that it will be practical for him to take trips just about anywhere, landing on or beside highways for stops at gas stations—and there is no technical reason why he shouldn't. He wants, in other words, a flying automobile —and he'll get it, if not from the old-line aircraft manufacturers, then from the powerful competition those manufacturers are sure to have after the war.

* * *

And we mean *tough*.

I Learned About . . .

(*Continued from page* 64)

moment the rate of climb would be showing 2,000 f.p.m. climb with the engine throttled and the airspeed reading 140 m.p.h. in a dive; the next minute it would be losing altitude at 1,500 feet per minute with the throttle wide open and the airspeed down to 85 m.p.h. in a climb. Granite peaks were getting mighty close. At the bottom of one of these unruly drops, I stopped dropping and started climbing so suddenly and forcefully, that my face smashed into the instrument panel. My face was cut so badly that I will always carry the scars. After about 20 minutes of this, the plane suddenly burst out of the storm clouds into brilliant sunlight and scattered fleecy clouds, with the city of Pocatello just ahead of me. A few minutes later I landed. One eye was completely closed, I could scarcely see out of the other eye, and my face and head were a swollen, bloody mess.

I resolved from that day hence to never again leave the ground without a safety belt in perfect working condition, and where it always belonged—on me.

END

Cargo Service

REPORTS reaching the New York office of Pan American-Grace Airways (Panagra) reveal that in the course of a single week over 30,800 pounds of cargo originating in the United States were carried out of Balboa, C. Z., by special Panagra freight planes. The majority of this cargo was consigned to Argentina, Peru, Chile and minor quantities to Colombia, Ecuador and Bolivia.

Panagra established this cargo service last August, supplementing the regular daily service between Balboa and Buenos Aires to help in the solution of the transportation problems caused by the reduction in normal steamer services as a consequence of the war.

By means of this special service Panagra transported nearly 80,000 pounds of freight south of Balboa in the first 10 weeks, in addition to thousands of passengers and huge amounts of mail and regular air express.

These services have been handling large quantities of cargo carried on special "space allowable" rates.

END

Observe and Report

(*Continued from page* 48)

them as instructors for other fields, a number of them to fight overseas. After the war, training activity at Brooks subsided for a number of years and the field was used as a lighter-than-air center. In 1922, a huge dirigible hangar with over 90,000 square feet of floor space was constructed and a complete school for balloon training was established.

Brooks Field came back as a flying school in September of that year. When Kelly Field became the home of the basic and advanced flying schools, Brooks took over the peacetime six months' primary course. Out of the Brooks Field training school have come some of the best known names in American aviation. From Brooks came Frank Hawks, holder of many world and national speed records. Also from Brooks came Orvil Anderson, co-holder of the world altitude record; Lester Maitland, the first man to fly the Pacific; Charles Lindbergh, graduated in 1924; Lieut. Col. Stanley Umstead, chief Army test pilot and the man who now flys the B-19, the world's largest bomber; and Gen. Claire Chennault, commander of the American pilots famous as the "Flying Tigers" of Burma and China.

END

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Maintenance Co-operation

(*Continued from page* 106)

that it was wing heavy at that time, but the pilot had not noticed it because he was too busy trying to instruct the student, and if he did notice it he probably attributed it to the poor student. This solo flight of 30 minutes by each instructor did a lot to pep up their flying. They tried different methods of acquiring precision in their maneuvers, and most important it gave them a chance to relax and just fly without regard to the effect on a student. A flight to relax is as important as a chance to get out to stretch on a long drive. Try it with your pilots and I am sure that you will be compensated through better instruction from relaxed instructors as well as more complete reports to your mechanics on the condition of the plane.

In order to insure that this increased volume of work you are expecting from your mechanics is done and that there is no duplication of effort, it is vitally important that you keep track of all work done. A record system must be set up so that it will list the small unimportant jobs as well as the major work. It is important that it be complete but simple enough to permit work to be recorded with a minimum of extra writing. Everyone hates paper work. A system that has been used successfully requires a minimum of paper work and filing. When a mechanic starts on a job he gets a clipboard for that plane and puts a job order on the board. This order lists the NC number of the plane and has lines for work done, materials used and, above all, a place for signatures. Each man that works on the job lists the work that he does, the materials used and the time spent. Then he signs for the work done. The job order has a carbon sheet and when the work has been finished the original is filed in a loose-leaf folder under that NC number and becomes a part of the log book for the ship. The carbon copy is filed as a permanent record for the shop. By having this worksheet the chief mechanic can be sure that the work has been done and that all inspections were made. If there was a mistake it fixes the blame and eliminates buck passing.

Mechanics all over the country have been reporting the findings of their inspections and from these it has been learned that certain planes develop difficulties that should be corrected. If this difficulty is prevalent all over the country, maintenance bulletins are issued by the manufacturer requesting that steps be taken to eliminate the condition. Then another bulletin is issued by the CAA requesting that the changes be made prior to the time that the plane comes up for relicensing. If this difficulty has given enough trouble to make the manufacturer think a correction is necessary and he is interested enough to have his engineers devise a remedy, isn't it to your advantage to follow his suggestions and complete the suggested change before it is demanded in order to continue the airworthiness certificate? Isn't it good maintenance to take advantage of the other fellow's troubles to insure your equipment against that same difficulty?

Maintenance is a co-operative problem and can only be successful if the pilot, mechanic and operator work as a team. On any team the best trained man is the coach and captain. The mechanic is in most cases the best trained man the operator has and is by far the most interested man. It is only fair that this man have an important and possibly leading voice in the maintenance problems of each operation.

Pilots are trained and started on a career as instructors in a period of a year, but in order to be a mechanic you must have at least a year on actual aircraft work and two years on engines (of which one year must be on actual aircraft engines). In addition to this there are written and practical examinations to be passed. After the mechanic has passed these examinations and has worked for almost nothing to get experience, he can go to work for from $100 to $250 a month, while a pilot with less time spent in training is drawing $250 to $400 per month. This is not a campaign to get more money for mechanics but an attempt to show that the mechanic you employ has spent a lot of time and money on an education to qualify himself to do a good job for you. He knows what it is to starve and work so that he can get what he wants, and when you find the going tough you can bet your last cent that the mechanic is sympathizing with you and understands what you are up against. Because he understands the problems of operations and because he is interested in his work to the point of self-sacrifice he will try to save every penny he can for the operator. It is up to you as an operator to see that this saving does not reach the point of skimping on needed work, and in your planning of work for your mechanics see that you do not skimp to the point where he cannot do a good job.

Why don't *you* as an operator and *you* as a pilot get together with your mechanic and work out the maintenance problems of your operations. A mechanic owes it to his operator to co-operate. A good round-table discussion will do wonders towards settling the maintenance problems that are present in most operations.

END

Seeks Wright Plane

GOVERNOR J. M. BROUGHTON of North Carolina has personally invited Orville Wright to sanction the return of the original Wright brothers plane (now in England) to the site of its first flight, Kill Devil Hill, N. C., where it would be housed in a suitable shrine.

Quality Checkers

THERE'S an inspector for each 13 production workers at Republic Aviation's booming Farmingdale, N. Y., plant. More than 20,000 separate inspection operations occurred on each P-43 *Lancer* pursuit.

Tough Baby

(*Continued from page* 48)

Lend-Lease gives you a good sense of security when it comes to a forced landing, even though the ship lands at a cool 55 and you may not have a decent field to sit down in. This student had just landed, only to have his ship swerve off 90° in the beginning of a tight ground loop.

The baffled embryo gave it the throttle in an attempt to get back in control, doing so before he realized that he was heading off the runway and straight for a patch of trees. Just as the ship got in the air it ran smack into those tall Carolina pines and the PT-17 turned into a high speed drill. It immediately started mowing down trees, shedding its wings as it rushed by the huskier ones. Before the ship had come to rest, it had plowed through several hundred yards of woods, but the cadet was still alive to tell the tale!

I've seen a solo student strike the ground at such an angle that he bent his propeller blades, said "crunch" to myself in anticipation of the crash, only to see the airplane bounce back into the air still in one piece. There are just no two ways about it, she's built out of "cast iron." Of course, payload was no worry for the engineers. Whereas some commercial planes, like the Bellanca, carried six passengers with the same power, the Stearman carries only two. The difference is reflected in that beefed up structure which will stand up under day-in and day-out student training.

Particularly in acrobatics, an instructor welcomes that extra "beef." Some cadets will give you a pretty rough go of it which doesn't help the airplane either. Inverted flight on any airplane is a strain on it but the stresses go up tremendously when violence is mixed into it. For example, when a student suddenly remembers to use forward pressure in a slow roll while inverted, or when an overzealous cadet dives her to 180 for an Immelman and pulls up with both hands. By the time you've put one class through acrobatic you know you'd be Superman if you ever took the wings off that ship. Friends of mine like to do inverted snap rolls and inverted spins in the Stearman just for the fun of it.

Flying it is not easy work. It was built to train military pilots, not pleasure pilots, and its design is intended to give the student the maximum appreciation of the various control pressures needed. You'll wear yourself out, for instance, working the ailerons in a Lazy 8.

Private pilots, with their modern planes equipped with brakes and wide landing gears, have long since forgotten the spirited challenge of a ground looping airplane. The PT-17, by contrast, retains some of the older traditions in this regard and until the Stearman whips you suddenly around in a complete circle you really don't know what a ground loop is. The ship is very touchy when it comes to landing with any side drift (even though it has brakes), but for-

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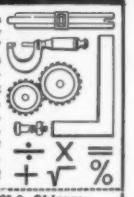

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tunately the usual damage is nothing more than scraped paint on the wing tip.

The PT-17, oddly enough, is a little brother to the mighty Boeing *Flying Fortress* being made by the Wichita Division of Boeing, which used to be the old Stearman aircraft factory. The PT-17, and its earlier military version the PT-13, is a direct outgrowth of a line of famous commercial airplanes built in the late 1920's. Many Stearmans flew the mail, while the C3-R powered with a Wright 220 was, and still is, a popular airplane for the private owner.

It is too early to hazard a prediction but we'll take this much of a chance and bet any one that the PT-17 will be to World War II what the old Curtiss Jenny was to World War I. Cadets and instructors alike will openly cuss the old Stearman's noise, its ground looping capers, its blustery cockpits. But deep down in their hearts every one of them will admit that "tough baby" has their undying affection.

END

15 YEARS AGO

FROM the March, 1928, issue of this magazine:

"To a great many men, aviation represents a sporting adaptation of an invention, a more or less impractical utilization of a device found handy in times of war . . ." declared James R. Monroe in the lead article, "Aviation as a Business."

* * *

The Pikes Peak Flying Club of Colorado Springs was taken as an "outstanding example of a newly organized, going and growing flying club" in an article on that subject by R. E. Ashbaugh.

* * *

Charles L. Lawrance, pioneer in the development of the air-cooled engine in America, was awarded the Collier Trophy for 1927. The Collier Trophy Committee for this year's award included Dr. George W. Lewis, Porter Adams, Charles J. Bell, Earl N. Findley, Edgar N. Gott, Emory S. Land, Carl F. Schory, Burdette S. Wright and Clarence M. Young.

* * *

The Curtiss O-11 pursuit plane, powered with a *Liberty* engine, was adopted as standard equipment for National Guard air squadrons.

* * *

Editorial: "When are the newspapers going to learn something about aviation! Reporters write glibly about corkscrew turns, air pockets and other non-existent things. . . . An Associated Press dispatch read: 'Utterly beyond control, his little craft went completely haywire, went spinning into a rain-drenched air pocket and finally turned upside down . . .!"

* * *

"An amendment . . . offered by Representative Henry M. Wurzbach of Texas, and approved by the House of Representatives, would authorize the War Department to accept from San Antonio citizens title to a tract of 2,400 acres, valued at $560,000, as a site for the Army's new primary flying school, to cost $700,000."

END

Letters

(Continued from page 66)

DFM for Yank

Sirs:—

My son, William D. MacMonagle . . . could not get into the American Air Forces as a pilot because of the two-year college rule. However, he could get into the RCAF and, after training in Canada, he completed his tour (600 hours) in the RAF and was awarded a DFM . . . Is the DFM the same as the DFC? . . .

WILLIAM E. MACMONAGLE

Akron, O.

● Commissioned officers in the RAF are awarded the Distinguished Flying Cross, noncommissioned personnel the Distinguished Flying Medal. Young MacMonagle, as a flight sergeant, received the latter.—Ed.

Wrong

Sirs:

Will you be kind enough to favor me with a statement as to why the photograph (page 163, September issue) has for its title "A Wright *Cyclone* being fitted to a Short *Stirling*, one of the RAF's most formidable four-engined bombers."?

It is a well known fact that the Short *Stirling* bomber is powered by Bristol *Hercules* sleeve-valve engines. This engine is so far superior to a Wright *Cyclone* that by no stretch of the imagination can the two be compared.

CURTIS J. PETER

Detroit, Mich.

● Reader Peter is wrong. The *Cyclone* is so good the British use it on the *Stirling*.—Ed.

Fan

Sirs:

At home in England I was for some six years a regular reader of your splendid magazine, but have not been able to obtain a single issue since I have been on active service with the RAF, Middle East Forces. (I did not miss a single issue in England and have had all the issues bound. Their value to me is priceless.)

I came out here some time ago and now I have thoroughly settled down to life out here. I have a most interesting job in the RAF, but naturally you will appreciate I am unable to give you any details, because of the strict censorship regulations.

You will understand that being such an enthusiastic reader of FLYING for some years I naturally miss reading it a lot out here, and there is no other magazine to take its place. . . .

I am, therefore, taking the liberty of asking you to send me about 12 different issues (back issues) of your magazine commencing with September, 1941. I am very anxious indeed to have a copy of this issue which, I believe, is a special one devoted to the history of the U. S. Army Air Forces. . . .

DENNIS M. POWELL
Aircraftsman
Royal Air Force

Middle East Forces

Spitter

Sirs:

I . . . must congratulate you on . . . "The Spitter" in FLYING recently as it brought back all the memories of my last station in England . . . on a "Spit" squadron. I must say it certainly shows up the *Spitfire* as the pilots and ground staff saw it—the fastest, most formidable and maneuverable fighter that has ever been built. What is more, I think it will remain in the top class, alongside the *Typhoon* and your own *Thunderbolt*, when it has some of the latest modifications installed. I have been in Canada only three months now but of all the aviation magazines here I like yours the best. In fact, I think it rates in line with the English magazine "The Aeroplane"—and that's saying something.

SERGEANT J. NOLAN,
Royal Air Force.

Pearce, Alberta, Can.

● Editors of The Aeroplane in London, please copy.—ED.

Spotter

Sirs:

In a recent issue you stated that the plane firing its wing guns in a picture is a P-40E *Kittyhawk*. This plane shows six wing guns. On a P-40E the wing guns are only four. I'm sure if you check on this plane you'll find it a P-40F *Warhawk*.

HARRY SCHAUB.

New York, N. Y.

● Reader Schaub is mistaken. The difference between the P-40E and F is not seen in the armament, but in the engine, cowling and air intakes. Both the P-40D and E have six .50 caliber machine guns in the wings. Details of the armament in the P-40F (*Warhawk*) are restricted. —ED.

Correction

Sirs:

May I amplify the incomplete account of British civil air transportation in war time given by your contributor, Roland Carter, recently. . . .

Imperial Airways, which your correspondent mentions, no longer exists, being one of the constituent companies of this corporation. [British Overseas Airways Corporation—ED.]

The corporation is operating many routes other than that from England to Lisbon, the only one mentioned by your contributor. This corporation operates in peacetime under an Act of Parliament, and is a non-profit-making organization. In wartime the whole undertaking is at the disposal of the secretary of state for air, by whom we are allocated the loads we have to carry. The corporation is at present operating over 40,000 miles of routes, and its aircraft by the end of the current year (March, 1941-42) will, it is estimated, have flown some 8,000,000 miles.

Besides the route from England to Lisbon . . . the corporation operates a flying boat service from England to West Africa; a landplane service across Africa, along the route pioneered by Imperial Airways in 1936 (there is an additional

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Besides these services, there are a number of others which are secret.

You will no doubt be glad to have these particulars for your information and perhaps to pass on to your contributor.

F. N. HILLIER
Press Officer
British Overseas Airways Corporation

London, Eng.

Due Credit

Sirs:

May I take issue with you regarding the opening sentences of your editorial in FLYING recently, which are as follows: "Battleships—at long last—are being put where they belong. As has been the case throughout history, a few people (crackpots, you know) foresaw what was coming and dared say so. Naturally, that small, imaginative group did *not* include any of the right people in Washington officialdom."

As a matter of fact, my late husband —George R. Rauch—being a member of the House of Representatives from Indiana, was on the sub-committee of the appropriations committee which appropriated funds for battleships and I am sure that a perusal of the hearings before that sub-committee prior to 1916, would disclose his efforts at that early date to allocate funds for an air defense for this country in place of some of the large battleships that were then being built.

Mr. Rauch happened to be "one of the small group which witnessed the historic first demonstration of a military plane by the Wrights at Fort Meyer, Va., in September, 1908"—quoting from Representative Maas's article entitled "The Billy Mitchell Case," also in FLYING.

Now Mr. Rauch's eldest son—Ens. George Rauch—is a Naval aviator, and his youngest boy has to content himself with building identification models and reading aviation magazines until he is old enough to fly.

(Mrs.) EMMA N. RAUCH.

Marion, Ind.

● We are only too happy to recognize, though belatedly, the far-sightedness of the late Congressman Rauch. Our reference to "the right people" did not exclude a number of Government men in Washington who foresaw the importance of air power. It did, however, refer to those men who controlled enough power at that time to have taken action, but didn't.—ED.

END

Spars by Radio

(*Continued from page* 34)

erning airplane builders always had required that wood spars be solid pieces, too. Previously it took days to dry out the glue, the glues in use were not always reliable and long drying-out often warped the wood. Thus, this was a rather expensive method of handling wood for very exacting jobs.

"But we'll see what we can do," agreed the Tolerton executives.

They recalled that only a short time before, a visitor had suggested a new method of making plywood quickly and cheaply for building pre-fabricated homes, and they had sent his idea along to the Radio Corporation of America, and the Forest Products Laboratory maintained by the Federal Government. Perhaps, they ruminated, his idea might help make wood spars of laminated pieces.

So they called on the Forest Products Laboratory and the Radio Corporation with the problem, sending on a supply of wood for experiments—and this new method of laminating the spars is the result. And this experiment also proved the poplar wood, very common in the East, to be just as good as spruce for this particular job.

When the first spars were ready, Wendt was called in for the tests. One spar was given a terrific test, each end being put into a vice, and these then were turned until the spar was twisted 180°. And Wendt's eyes bulged.

"Wood just can't be that good," he commented.

But it was. For no ordinary solid spar would stand such punishment or abuse without cracking or breaking, this laminated spar took it all in its stride. Released from the vices, it promptly snapped back to its original shape, showing no signs of the abuse.

Next came the load tests, more abuse. Now in load tests of those Taylorcraft wings built with solid wood spars, the engineers found they failed generally at about 115 per cent of design load. While Taylorcraft planes weigh only about 1,300 pounds fully loaded, they are designed to carry a load of 10,000 pounds or 5,000 pounds on each wing. Thus, they would fail when about 5,750 pounds were piled on each wing.

Taylorcraft workers built up a sample wing with the laminated spars. So then Taylorcraft and Tolerton engineers and executives held their breath while workers piled bag after bag of lead shot on the wing.

It was especially a tense moment when the critical point of the tests were reached —the moment when the 5,750 pounds of shot was piled on. Nothing happened. So workers piled on more bags of lead shot, and more bags. Finally the foreman approached Wendt and said:

"We got to quit, boss."

"Why?" demanded Wendt.

"No more lead shot in the place," explained the foreman.

The staggering burden on the wing already was more than 8,000 pounds—or 160 per cent of design load—and still the wing was intact and undamaged.

Taylorcraft then began the job of inducing the CAA to revise its regulations to permit use of the laminated spars; and once their worth was proved, the CAA's regulations promptly were changed.

Now these laminated spars are being universally used by Taylorcraft in making its Army trainers, liaison ships and gliders, and Piper and Aeronca have used some, too.

And the Tolerton company, preparing for the rush of business, needed a new radio station. It found one which had been built for a broadcasting company, but had been frozen by the War Production Board before delivery. Informed of its intended use, the WPB gladly issued a priority to the lumber company permitting its diversion. The Federal Communications Commission assigned call letters, and permitted the lumber company to begin broadcasting signals that never go outside its shop.

Thus the lumber company is in the radio business—to help aviation with its lumber problems.

END

THE LIBRARY

AEROSPHERE 1942. 9½ pounds. Published by Aircraft Publications, New York City. Edited by Glenn D. Angle. $12.50.

By far the biggest aviation publication of its kind ever to be produced, Aerosphere 1942 is an excellent reference book to have around if you are in aviation—and if you can afford it. This giant can best be described by saying it is a book combining the features of the famed British Janes All the World's Aircraft, the American Aviation Directory, the Aircraft Yearbook of the Aeronautical Chamber of Commerce and the classified section of the telephone book. There is hardly a thing the aviation researcher will not find somewhere under some subheading, although the system of classifying the various sections is, considering the whole book, too complex.

Nowhere in the publication is there a single, main index where the user can look up anything anywhere in the volume. The standard system of numbering pages consecutively from front to back has been abandoned, probably because of the many production problems connected with such a huge book. The reader, then, must first consult the contents page (which is in a section bearing those mysterious Roman numerals), then look up the index for the particular section in which he is interested.

When considering Aerosphere 1942 only from the standpoint of its being an American Janes, there are certain drawbacks we feel justified in criticizing. In the American section particularly, aircraft are listed that we had long since forgotten until we looked through this volume. There are such space-filling listings as the Gwinn *Aircar*, a novel "safety" plane of several years ago which never got into production and probably never will. There is a half-page listing, with photograph and technical data, on the old experimental model of the Douglas DC-4 which was sold to the Japs years ago. One photograph in the Japanese section, incidentally, caught our eye. It is a flight view of a U. S. Navy Douglas *Devastator* (TBD) torpedo bomber, with the Navy markings retouched off. The caption labels it a Mitsubishi Type 97/1, though three healthy-looking Navy airmen are plainly visible in the cockpits.

Despite such discrepancies, however, we still recommend Aerosphere 1942. Considering the circumstances under which we know Mr. Angle had to work, the book is very well done and should take its place among the country's most important reference books.—M. K.

END

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INDEX OF *Advertisers* MAR. 1943

COMPANY	ADVERTISING AGENCY	PAGE NO.
Aeronca Aircraft Corp.	Paris & Peart	98
Aircooled Motor Corp.	Spitz & Webb, Advertising	13
Aircraft on Parade	Julian R. Bessl & Associates	138
American School	Reincke-Ellis-Younggreen & Finn, Inc.	151
American School of Aircraft Instruments	West-Marquis, Inc.	147
American Technical Society	Reincke-Ellis-Younggreen & Finn, Inc.	142
Anderson Air Activities	Evans Associates, Inc.	83
Atlantic Aviation Institute, Inc.	Broomfield-Podmore Advertising	144
Aviation Service Corp., Ltd.	Stevenson & Scott Ltd.	149
Beech Aircraft Corp.	The McCormick-Armstrong Co.	99
Bell Aircraft Corp.	Addison Vars, Inc.	103
The Biltmore	Kelly, Nason, Inc.	148
Boeing Airplane Co.	N. W. Ayer & Son, Inc.	117
Boots Aircraft Nut Corp.	Cecil & Presbrey, Inc.	8-9
Cessna Aircraft Co.	Gardner Advertising Co.	2nd Cover
Champion Spark Plug Co.	McManus, John & Adams, Inc.	96
Chicago School of Aircraft Instruments	Smith, Benson & McClure, Inc.	125
Chicago Technical College	Buchanan & Company, Inc.	139
Classified		150
The Cleveland Model & Supply Co.	The Carpenter Adv. Co., Inc.	148
Cleveland Pneumatic Tool Co.	The Bayless-Kerr Co.	89
Commonwealth Aircraft, Inc.	Merritt Owens Advertising Agency	109
The Computractor Co.		149
Continental Motors Corp.	Wallace-Linderman, Inc.	115
Culver Aircraft Corp.	The McCormick-Armstrong Co.	107
Curtiss-Wright Corp. Airplane D'v	Baldwin & Strachan, Inc.	104
Curtiss-Wright Propeller Div	Burke Dowling Adams, Inc.	85
Curtiss-Wright Technical Institute	Oscar Nordin Co.	5
Dallas Aviation School & Air College	The Magnolia Advertising	121
Eastern Aircraft Instrument School	Eastern Advertising Agency	143
Embry-Riddle School of Aviation	John E. Vodicka, Advertising	136
Fleetwings, Inc.	The Aitkin-Kynett Co.	76-77
Funk & Wagnalls Co.	Franklin Spier & Aaron Sussman, Inc.	133
The General Tire & Rubber Co.	D'Arcy Advertising Co.	79
GHQ Motors	Arthur A. Winston, Sales & Adv. Serv.	149
Goodyear Aircraft Corp.	Arthur Kudner, Inc.	6-7
Gordy Publishers	A. N. Baker Advertising Agency, Inc.	149
Gulf Oil Corp.	Young & Rubicam, Inc.	10
Gun Model Co.	E. H. Brun, Advertising Agcy.	150
The Hallicrafters, Inc.	Burton Browne, Inc.	130
Harley-Davidson Motor Co.	Klau-Van Petersom-Dunlap Associates	138
Heath Company	The Paxson Advertising	14
Indiana Technical College	N. W. Ayer & Son, Inc.	149
Indian Motocycle Co.	Tracy, Kent & Co., Inc.	145
International Correspondence Schools	N. W. Ayer & Son, Inc.	66-141
Jacobs Aircraft Engine Co.	Alan P. Lyster Advertising	17
Jones, Cassy School of Aeronautics	Craven & Hedrick	124
Joyce Aviation, Inc.	Blackett-Sample-Hummert, Advertising	66
K. C. Card Co.	Chicago Union Advertising Agency	149
Koh-I-Noor Pencil Co., Inc.	Roeding & Arnold, Inc.	134
Kollsman Aircraft Instruments	Erwin, Wasey & Company, Inc.	15
Kuns, Ray		149
Lear Avia, Inc.	Roy S. Durstine, Inc.	12
Lewis School of Aeronautics	Frank C. Nahser, Inc.	123
Lincoln School of Aeronautical Institute	Buchanan-Thomas, Advertising Co.	143
Littelfuse Inc.	Merrill Symonds Advertising	92
Lockheed Aircraft Corp.	Foote, Cone & Belding, Inc.	Back Cover
Lycoming	Hutchins Advertising Co., Inc.	97
McDonnell Aircraft Corp.	D'Arcy Advertising Co.	152
McGraw-Hill Book Co., Inc.		148
National Radio Institute	Van Sant, Dugdale & Co., Inc.	149
Nelson Co.	A. N. Baker Advertising Agency, Inc.	143
Northrop Co., Inc.	J. Walter Thompson Co.	81
Pan-American Navigation Service		151
Parks Air College, Inc.	Oakleigh R. French & Associates	3
Piper Aircraft Corp.	Hutchins Advertising Co., Inc.	65
Pitman Publishing Corp.	James R. Flanagan Adv. Agency	74-75
Pump Engineering Service Corp.	Fuller, Smith & Ross Inc.	67
Republic Aviation Corp.	Cowan & Dengler Inc.	111
Rohr Aircraft Corp.	Barnes Chase Company	113
The Ronald Press Company	Grant & Wadsworth, Inc.	127
Roosevelt Aviation School	Victor A. Smith Advertising	129
Hotel Roosevelt	Kelley-Nason, Inc.	142
Ryan School of Aeronautics	The Essig Co., Ltd.	131
Solar Aircraft Co.	Logan & Arnold Advertising Agency	90
South Bend Lathe Works	Lamport, Fox & Company	93
Spartan School of Aeronautics	The Potts-Turnbull Company	119
Stanzel, Victor & Co.		149
Stewart Technical School	Ruthrauff & Ryan, Inc.	135
Tinnerman Products, Inc.	The White Advertising Company	71
Trans-American Airports Corp.	James R. Flanagan Adv. Agency	151
Tri-State College	Clem J. Steigmeyer Advertising	144
The Waco Aircraft Company	Spencer W. Curtiss Inc.	101
The Weatherhead Co.	Meermans, Inc.	73
Weems System of Navigation		116
Wittek Mfg. Co.	The Advertising Corporation	16
Wright Engines	Burke Dowling Adams, Inc.	3rd Cover
Wm. Wrigley Jr. Company	Ruthrauff & Ryan Inc.	11

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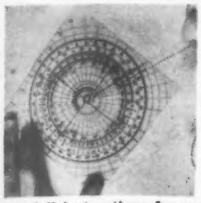

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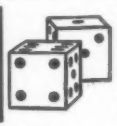

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The Nose of the Wing

(*Continued from page 63*)

be in order to retain the same efficiency. Anything protruding through the boundary layer disturbs the laminary flow and increases the region of turbulency. A sketch and a note in Section 5 shows the increase of drag with the increase of the rivet heads and the number of rivets. It also indicates that with the increase of the rows of rivets the drag will not increase proportionately if the air is disturbed by the first row. For the reason prefabricated, smooth leading edge units are used in production.

In Section 6 the effect of protuberances is shown. Streamlining those protuberances will not greatly alter the coefficients of the basic section.

As mentioned in the above, the boundary layer becomes thinner as the speed increases. Therefore the surface texture must be smoother for higher speeds. At low speed the texture does not influence the drag of an airfoil as plotted in a diagram in Section 7.

One problem of aviation will always be the icing of the wing, which is usually accompanied by a rapid loss of its lifting power. Nature has a tendency to counteract any work to be done by the simplest, easiest and most efficient method it finds available; by the method of "least work." Of the many methods of nature to prevent flying is the icing of the wing by changing the wing section right at the leading edge with a minimum of material. Because of the sensitiveness of the leading edge, nature builds up an ice "nose" pointing upwards. On pointed sections only a small amount of icing is required as shown in a sketch in Section 8. On blunt-nosed sections it would take longer to do such forming. So it deposits ice similar to the second sketch. De-icers are therefore designed to have two or more breather boots as illustrated in the next sketch.

The two airflow patterns in Section 9 show that the increased angle increases the turbulency. By placing a small airfoil ahead of the wing additional air will be forced downwards. This function of an auxiliary wing (slot) was foreseen in the early days of aviation by Coanda (France) in 1910. However he placed the small airfoil as sketched in Section 10, having the impression that the air should be deflected upwards instead of towards the upper surface of the wing. Another idea was the outcome of the airfoil shown in the same section, the Eiffel No. 48. The theoretical fact was that if the leading edge does all the lifting, then three leading edges should do three times as much. Tests showed that the drag increased by 100 per cent and the lift decreased by 40 per cent. Another idea which has a certain theoretical background is illustrated in the bottom sketch. By creating a vacuum at the cut-out the friction should be reduced.

Three different slots are outlined in Section 11. The maximum lift coefficient, the gliding angle and the ratio of the maximum lift and minimum drag

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coefficients are noted for the slots and for the wing without slots.

The propeller location depends on the design of the nose. The propeller axis is usually placed parallel with the upwash stream. The blunter the nose the greater must be the ratio of the distance and the propeller diameter. (Section 12.)

The outline of the leading edge of a bird wing is different at rest from that when in the air. The suction of the airflow pulls out the feather as indicated by the full line, as illustrated in Section 13. Some designers followed the outline of the bird wing when at rest with the idea that this double camber will increase the lift. Some birds, especially the scavenger soaring birds, have a small feather (thumb) ahead of the primary feathers that has the function of a slot. A sketch in Section 13 shows its location. It may act as an automatic feeler for the primary feathers.

The influence of the nose of the wing relative to the outline of the fuselage is given in Section 14. It gives the maximum lift and the minimum drag coefficients for a streamlined and a cambered section. It shows that as long as the airflow over the airfoil is parallel with the airflow past the fuselage the highest efficiency is obtained.

Some inventors suggested moving more air over the upper surface by rotating leading edges. Three designs are illustrated in Section 15. On small models they showed great improvement. On a full-sized airplane the increase was negligible. One used a rotating cylinder; another a series of rotating discs; one even suggested an endless belt.

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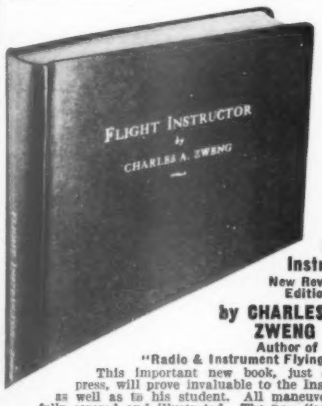

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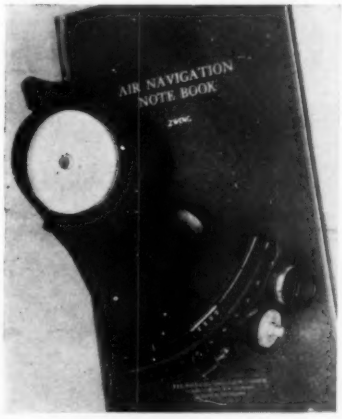

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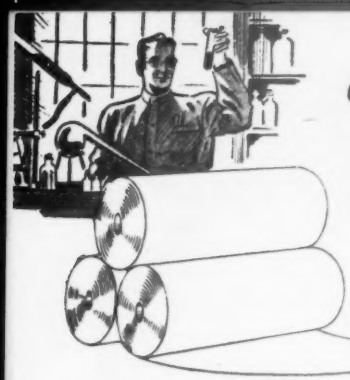

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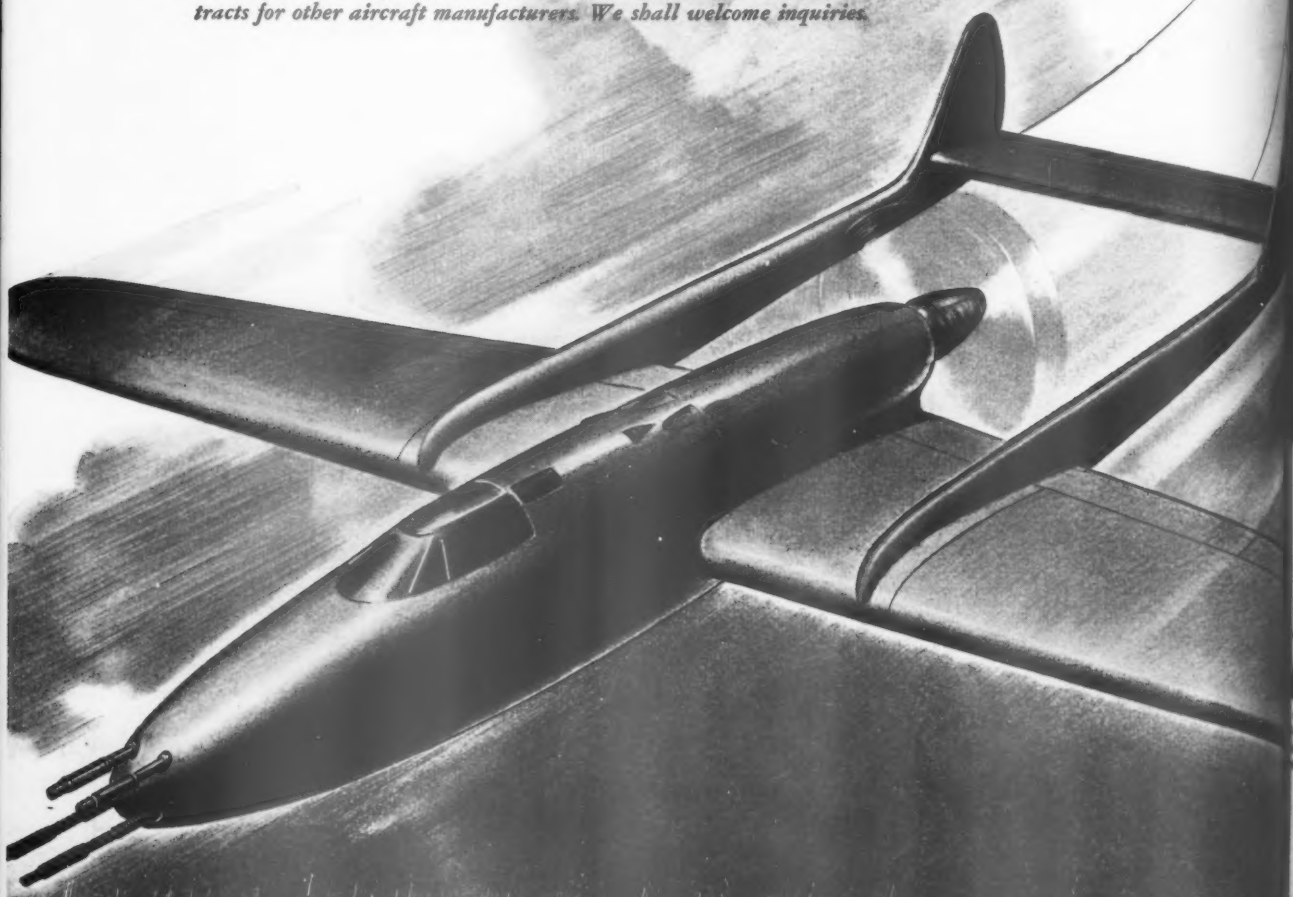

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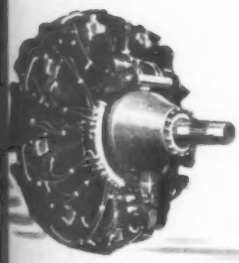

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